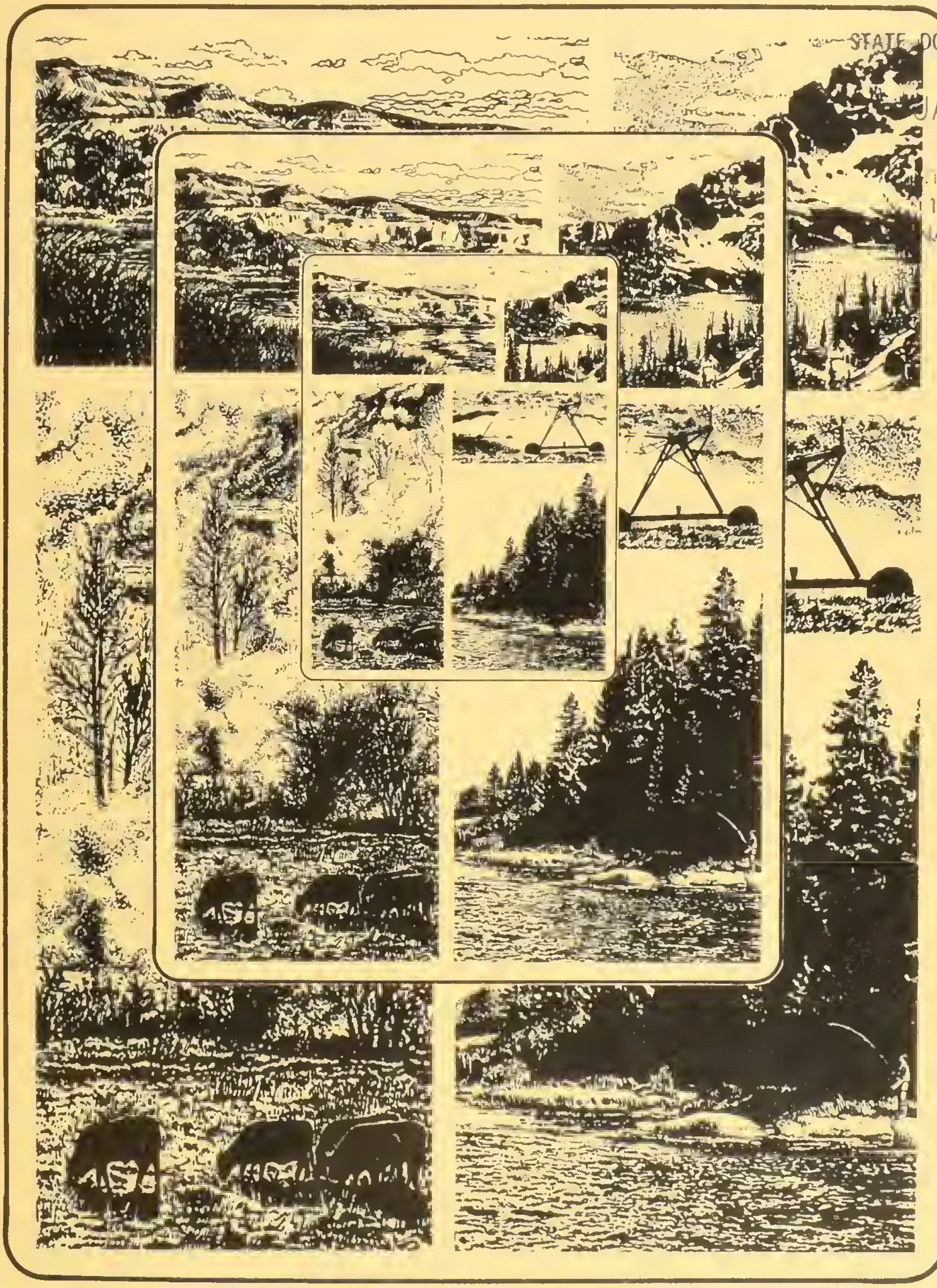
MONTANA



WATER QUALITY

1982

Montana Water Quality

Prepared by the Water Quality Bureau
and the
Environmental Sciences Division
Department of Health and Environmental Sciences
Helena, Montana 59620
with assistance from the
Montana Operations Office
and the
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July 1982

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summary

PROBLEM ASSESSMENT

Water quality problems are outlined in each of the following categories:

Streams—There are 216 apparent and potential problem stream segments in Montana. Recent data were available to evaluate problem severity on 99 segments. Of these, 32 problems were judged to be largely man-caused and improvable under the existing regulatory framework and pollution control programs. Muddy Creek near Great Falls is Montana's worst documented water quality problem.

Lakes—A new statewide lakes inventory and computerized data base made it possible to identify lakes in which one or more beneficial uses have been affected. The 20 most significant lakes with impaired uses are listed.

Wetlands—Water quality in most Montana wetlands is generally suitable for production of waterfowl. Precious little is known about Montana wetlands except that they are disappearing. The National Wetlands Inventory is just beginning and is expected to answer many questions about the quality and quantity of the state's wetlands.

Groundwater—Groundwater represents only a small fraction of the water used in Montana, but it is often the only available source of potable water. Principal sources of groundwater are alluvial aquifers and the Eagle and Fort Union formations. Major categories of groundwater contamination are saline seep, mining, accidental spills and leakage, septic tank drainfields, oil and gas exploration and development activity, solid waste disposal sites and municipal and industrial wastewater disposal systems. Although there are many isolated cases of groundwater pollution from surface activities, Montana is fortunate in that there has been no widespread contamination of drinking water aquifers.


Montana Travel Promotion Bureau

SPECIAL PROBLEMS

Leaving aside for the moment Montana's "Big Three" water quality problems—sediment, salinity and water depletion— the Water Quality Bureau (WQB), Department of Health and Environmental Sciences (DHES), discusses here what it believes will be the water quality issues of the future:

Acid Deposition—Low alkalinity lakes in northwestern and southcentral Montana are susceptible to acid deposition. Snow falling on the mountains in the southwestern corner of the state has been in the pH range of 4.0 to 5.0, which is more acidic than normal.

Ammonia—Wastewater discharges from eight Montana community treatment plants are thought to be causing some degree of ammonia toxicity to aquatic life in streams receiving the discharges. Studies are continuing.

Energy Development—With abundant reserves of coal, oil, gas and hydropower, Montana is, and will continue to be, one of the most important energy producing states in the country. Development of these sources will require careful planning to avoid pollution of surface and groundwaters.

Placer Mining—Placer mining in Montana has increased dramatically with the recent upswing in the price of gold. Placer mines are numerous, portable and short-term, making them very difficult to monitor. State agencies are working with placer miners to reduce sedimentation and destruction of riparian habitat.

Toxics—A variety of synthetic and potentially toxic chemicals are released into Montana's environment. Fortunately, our waters and fish are still relatively free of toxic substances.

CONTROL PROGRAMS

Brief reports are given on status, accomplishments, problems and objectives for each of the WQB's principal water pollution control programs.

Monitoring—Components of the WQB monitoring program are fixed-station ambient monitoring, biological monitoring, intensive surveys, quality assurance and data management. Because traditional fixed-station monitoring is so expensive, the WQB is putting more emphasis on site-specific intensive surveys of known or potential problems. Quality control and data management are integral parts of all the WQB monitoring.

Public Water Supply—The number of regulated public water supplies in Montana is six times larger than what it was a few years ago. Monitoring indicates that most supplies continue to provide safe, palatable water, although many are plagued by natural impurities.

Permits and Enforcement—This section is the regulatory arm of the WQB, which administers four different sets of pollution control regulations and more than 400 discharge permits. The number of permit applications, water pollution complaints and reported spills of oil and hazardous materials has increased remarkably in recent years. To cut paperwork, the WQB proposes to issue general permits covering a wide variety of minor pollution sources.

Construction Grants—If funds currently authorized for Montana ($12 million per year) are appropriated by Congress, Montana's major wastewater treatment needs will be met by the end of Fiscal Year (FY) 1986. During the last two years, the DHES passed on to local governments more than $38 million for the construction of wastewater treatment facilities to improve public health and water quality. More than $50 million worth of work needs to be done on wastewater treatment in Montana to bring existing facilities into compliance and to eliminate documented public health hazards.

Technical Studies Support—During the past two years, Montana's surface water quality standards have been revised, ammonia, oil and grease permit limits have been reviewed and new rules to implement the state's non-degradation law have been prepared. Developments reviewed for their impact on water quality include lakeshore subdivisions, new and modified hydroelectric power plants, new and modified mining developments and new municipal discharges.

Water Quality Management—Planning efforts to control nonpoint source water pollution in Montana have been largely in the areas of agriculture, forestry and mining. Sharing in these efforts are the WQB, two of the four original areawide planning organizations, several Indian reservations and a host of local, state and federal government agencies. Funds for correcting nonpoint source pollution problems are woefully inadequate.

GOALS AND ATTAINMENT

The Clean Water Act goal of "fishable and swimmable waters" by 1983 will not be met for more than 200 stream segments in Montana. Without an infusion of implementation funds for correcting existing nonpoint source pollution problems, the list of problem segments won't be much shorter when our next water quality report is written in 1984. But with adequate funding for the pollution control programs described in this report, the list should not be longer.

introduction

The Federal Clean Water Act, in Section 305(b), requires each state to prepare and submit to the Environmental Protection Agency (EPA) a periodic assessment of water quality. The 1982 report takes on a somewhat different look with several changes from past reports. For the first time the report attempts to identify and rank known and potential problem stream segments in Montana. This task proved extremely difficult and we can only hope it will provide guidance for our future efforts.

We look to this document to not only discuss program accomplishments during the previous two years, but more importantly to provide the basis for program direction in the coming years. Although, as pointed out in the report, data of a totally comparable nature do not exist for each stream segment, the data must be utilized as best available information.

The number of problem stream segments should not be construed to be a reflection of declining water quality, but rather attributed to increased awareness and improved assessment techniques. Significant information has been gathered in recent years which has given us a more accurate assessment than ever before.

This report represents as thorough a summary as has ever been prepared on the condition of Montana waters. We hope it is as valuable to others as it will be to us in carrying out our responsibilities under the Montana water pollution control program.

Steven L. Pilcher, Chief
Water Quality Bureau

Department of Fish, Wildlife and Parks

problem assessment

The WQB inherited a backlog of water quality problems that occurred before strict laws and regulations were passed to prevent further degradation. These problems stem from the heydays of resource exploitation in Montana, some of them from before the turn of the century. They represent abuses to the state's forest, mineral, soil and water resources at a time when the prevailing philosophy was "let the good times roll." The good times went bad and along with them much of Montana's high quality water. Cleanup will be expensive, prohibitively so in many cases.

These water quality problems are treated categorically by streams, lakes, wetlands and groundwater. For streams and lakes, descriptions of the methods used to identify and rank the most serious problems are discussed along with the efforts currently underway to correct them. Precious little is known about wetlands in Montana, except that they are disappearing.

Once polluted, groundwater aquifers are slow and nearly impossible to clean up, hence the emphasis in the groundwater section will be on identification of potential pollution sources and programs to prevent new pollution. Fortunately, Montana has relatively few documented cases of groundwater pollution. But some are very serious and will be with us for a long time.

The purpose of these assessments is to direct water quality management activities. This is particularly important today because of the few resources available to correct a large number of pollution problems. The key is to manage for maximum environmental effect.

STREAMS

This is the first published attempt to identify and rank apparent and potential problem stream segments in Montana. With all the difficulties, it is easy to see why.

There is no central source of stream water quality information in Montana. Basic information is not available for many apparent problem segments and when it is, it is frequently old and obsolete. For those segments with recent data, coverage is sporadic and inconsistent, making stream-by-stream comparisons tenuous at best. There is a great deal of variation in parameter and station coverage, information reliability, timing and frequency of sampling from one segment to another. Hence, the results of this ranking must be used with caution, and only as a first approximation.

Trend analyses were not attempted for these same reasons. Water quality in Montana streams is highly correlated with seasonal fluctuations in the natural hydrologic cycle. High streamflows are associated with naturally large concentrations of sediment and high turbidity; low streamflows are associated with larger concentrations of dissolved materials and lower turbidity. If year-to-year water quality samples are not taken during comparable times in the hydrologic cycle—which is often the case—then the apparent water quality trend will be an artifact of sample timing and the true trend will remain unknown. Even if year-to-year samples are from comparable points on the hydrologic cycle, there will be differences in streamflow, which must be factored into the quality analysis. In many cases streamflow information is not available and if it is, there is no way to statistically weight streamflows or treat time-series data in order to arrive at a true and reliable assessment of water quality trends.

Of these problems, the most serious impediment to severity and trend analysis is the scarcity of regular monitoring data from apparent and potential problem segments. Because of the great expense involved in monitoring, only the federal government can afford to do the bulk of the water quality monitoring in Montana. The federal monitoring network has been geared largely to energy impact areas and to national trend monitoring. Hence, the stations tend to be concentrated in southeastern Montana and on the larger rivers where pollutants are more readily diluted and where pollution sources are obscure and problematic. Of the 216 apparent and potential problem segments identified in the Appendix, only a handful have regular monitoring data.

This discussion of problem stream segments is divided into three parts: 1) a description of the method used to identify and rank the apparent and potential problem segments, 2) a detailed description of the problem segments and 3) a discussion of current and available control efforts for reclaiming priority problem segments where improved water quality is attainable. This stream segment severity analysis has uncovered many significant data gaps, which will be addressed in the section on monitoring.

METHOD

The method used to identify and rank apparent and potential problem stream segments in Montana is a variation of a technique developed by the EPA, Region VIII. It is based on the number of times and the degree to which specific water quality criteria are exceeded. If a criterion is exceeded, it is assumed that an existing or potential beneficial use is impaired. If a beneficial use of water is impaired, then the water is presumed polluted and a problem exists. Implicit in the technique are other assumptions, which are explained below.

The assessment method that the WQB applied to Montana stream segments had many steps:

Step 1) A criteria matrix was prepared in which values of individual variables (parameters) were shown for the six beneficial uses (Table 1). Values for each criterion were adjusted to reflect Montana conditions and water quality standards. It was assumed that each segment is now, or has the potential of, being used for five of the six beneficial uses: warm or cold water aquatic life, drinking water supply, primary contact recreation, irrigation and livestock watering. The livestock watering category might also apply to wildlife watering. It was also presumed that conventional potable water treatment technology generally is not effective for removing or treating all constituents under the public water supply category in the matrix. It should be noted that few problem stream segments are now used for public water supply, even though criteria for this use were applied to all segments;

Step 2) All apparent and potential problem stream segments in the state were listed using published reports and other reliable sources. The twelve sources that were used are cited in the Appendix. Documentation of a problem with actual water quality data was not necessary for a stream segment to be listed;

Step 3) Selected water quality data for potential problem stream segments in designated 208 Water Quality Management Planning areas were coded and entered into the EPA data storage and retrieval system (STORET). (Most of the Montana areawide 208 information had not been entered into STORET.) Also, all the data in the Montana water quality data storage and retrieval system as of January 1, 1982, was put into STORET. It was presumed that all water quality information accurately represented instream conditions and met EPA quality assurance guidelines;

Step 4) Agencies and stations having data in STORET for each of the listed potential problem stream segments were identified;

Step 5) From among the state stations in STORET, a maximum of two stations that best represented water quality conditions in each segment were selected. All the U.S. Geological Survey (USGS) and selected EPA stations were included;

Step 6) All the STORET station numbers and agency codes from Step 5 were submitted to the Data Analysis Branch of the Environmental Services Division, EPA Region VIII in Denver. Stations not having the parameters in the criteria matrix or data collected after January 1, 1976, were eliminated from further consideration. The remaining, post-1975 information was then subjected to a problem severity analysis using the customized Montana criteria matrix and a computer program developed by the Data Analysis Branch.

A list of monitoring stations used in the severity analysis is available on request from the WQB;

Step 7) At each station, the EPA computer analysis yielded a numerical use-impairment value for each of the six beneficial uses in the criteria matrix. Each value was based on the number of times and the degree to which Montana water quality criteria were exceeded. These use-impairment values were translated into problem segment severity index values by the following procedure:

a) Use-impairment values were added for each station for five of the six uses, excluding either warm or cold water aquatic life, whichever did not apply, resulting in a station severity index;

Table 1. Water quality criteria matrix (milligrams per liter unless otherwise noted). Beneficial Uses: *1--cold water aquatic life; 2--warm water aquatic life; 3--public water supplies; 4--primary contact recreation; 5--irrigation; 6--livestock watering.

	*1	2	3	4	5	6
Dissolved oxygen	7.0	5.0				
Fecal coliforms (no./100 ml)				200	1000	
Nitrite as N	0.05	0.5	1.0			10.0
Nitrate as N			10.0			
Nitrite and nitrate as N						100
Total ammonia			0.5			
Un-ionized ammonia	0.02	0.04				
Total inorganic N	0.35	0.35				
Total phosphorus	0.05	0.05		0.05		
Total phosphate	0.05	0.05		0.05		
Total dissolved solids			500		1200	1000
Conductance (micromhos/cm)					2500	
Turbidity (NTU)	10	50				
Total suspended sediment	30	90				
Chloride			250		700	
Sulfate			250			
Cyanide			0.2			
Magnesium					160	
Sodium					160	
Sodium adsorption ratio					3.0	
Fluoride			2.4		15.0	2.0
Arsenic	0.44	0.44	0.05		0.10	0.20
Barium			1.00			
Boron					0.75	5.00
Chromium VI	0.021	0.021	0.05		1.00	
Iron	1.0	1.0	0.3		2.0	
Manganese			0.05		10.0	
Selenium	0.26	0.26	0.01		0.02	0.05
Mercury	0.004	0.004	0.002			0.010
Temperature (C)	19.4	26.6				
Temperature (F)	67.0	80.0				
Copper			1.0		5.0	0.5
Lead			0.05		10.0	0.10
Zinc			5.0		10.0	25.0
Cadmium			0.01		0.05	0.05
Chromium III			178			
Nickel			0.015		2.0	
Silver			0.05			
pH (minimum)	6.5	6.5	6.5	6.5	4.5	
pH (maximum)	8.5	9.0	8.5	8.3	9.0	

b) The station severity index values for all stations in the potential problem segment were added, then divided by the number of stations, yielding an average station severity index for the segment;

c) The number of uses impaired were counted and translated into a decimal fraction as follows: a) one, 0.2, b) two, 0.4, c) three, 0.6, d) four, 0.8, e) five, 1.0. and

d) The average station severity index value for the segment was multiplied by the appropriate decimal fraction, resulting in the final adjusted average severity index value for the segment;

Step 8) Finally, the adjusted average severity index values for problem segments were qualified with certain non-quantifiable factors that influence and reflect the severity and relative importance of each pollution problem. These are the factors:

a) Downstream use(s) impaired (code letter A)

This factor was applied if one or more uses in the next downstream lake or stream segment were likely impaired due to pollution originating in the problem segment.

b) Improved water quality attainable (code letter B)

This factor was applied if the problem is largely man-caused and manageable under existing regulatory authority and pollution control programs, assuming adequate funding for cleanup is provided.

c) Large population affected (code letter C)

Some problem segments are in Montana's more populous areas where immediate and downstream impacts affect a large share of the state's population. In other cases, such as Ashley Creek/ Flathead Lake and the Madison River, the change in water quality can assume statewide or even national importance.

d) Valued resource affected (code letter D)

In most cases, the criterion for this factor was whether the problem affected a "highest-value fishery resource" as defined by the Montana Department of Fish, Wildlife and Parks (DFWP). This stream classification is similar to the "blue ribbon" classification formerly applied by the DFWP to designate the best quality fishing waters in the state. In other cases, such as Little Peoples Creek in the Little Rocky Mountains, the factor was applied to waters that are locally unique, although not among the most prized statewide.

e) Interstate, national or international issue (code letter E)

This rarely used factor was applied in cases where the pollution problem crosses a state or international boundary or, in the case of the Madison River, where a nationally-famous trout stream is directly affected.

f) Local interest and involvement (code letter F)

The principal criterion for this factor was whether the local conservation district identified the problem in its water quality plan. Other expressions of local interest also were considered.

g) Unnatural flow fluctuation (code letter G)

Unnatural flow fluctuations can add another element of stress to fish and aquatic life. Excessive withdrawals for irrigation can result in critically high summertime temperatures, concentrated pollutants and other water quality problems. The criterion for this factor was whether the problem segment in question has "water removed or fluctuated for agriculture, power, industry, municipal or other" purposes as recorded in the Montana Interagency Stream Fishery Data Base. Information in this category was provided by the DFWP.

The method used to generate the problem segment severity index values is unique to Montana, although the overall approach is similar to one recommended by EPA Region VIII. Significant deviations from the EPA method are 1) the actual water quality criteria values, 2) the number of beneficial uses considered, 3) a factor adjusting the index value based on the number of beneficial uses impaired and 4) the number and kinds of qualitative factors applied. These severity index values are intended only as a guide for allocating available resources and for directing water quality management activities within the State of Montana. They can not, and should not, be compared with other states' values either to assess relative problem severity or as the basis for allocating water pollution control funds nationally or within Region VIII. It should also be remembered that data are lacking or obsolete for a number of Montana's significant problem segments for which no numerical rating was possible.

PROBLEM SEGMENTS

Using the method just described, the WQB identified 216 apparent and potential problem stream segments. These are mapped and listed in the Appendix by drainage basin. Also listed in the Appendix for each problem segment are the 1) receiving water, 2) probable impaired uses, 3) suspected pollutants, 4) pollution sources, 5) problem references and 6) final qualified severity index value. Entries for the "probable impaired uses" and "suspected pollutants" categories were based largely on professional judgment and information contained in the 12 principal references. In many cases these entries do not agree precisely with information derived from the computerized data analysis.

Of these 216 problem segments, more than half (117) did not have recent (post-1975) data in STORET and therefore could not be ranked with the rest. It can be argued, with some justification, that the problem segments lacking recent data are generally lower priority problems than those segments for which recent data have been collected. However, this category also includes some notorious water quality problems of long standing, for example, Hot Springs Creek and Soda Butte Creek. These and other selected data-poor streams should be targeted for intensive surveys and data updates (See Monitoring), together with those problem segments where recent control measures may have effected some improvement since the last sampling.

The remaining 99 problem segments had at least some post-1975 data with which to prepare a severity index and a numerical ranking. Of these, 67 segments either had severity index values equal to zero or problems judged to be largely natural in origin although intensified by human activities. For the natural problem segments, the WQB presumes that a significant improvement in water quality is not attainable.

The final subset of 32 problem segments includes those for which data are available, the problems are largely man-caused and improved water quality is attainable within the existing regulatory framework and pollution control programs. These 32 segments are listed in Table 2 and mapped in Figure 1. Biological monitoring and intensive surveys have confirmed some degree of aquatic life impairment in 15 of the segments.

Table 2. Stream segments having apparent and potential man-caused water quality problems that could be improved significantly by existing regulatory authority and pollution control programs, funds permitting.

Map No.(1)	Stream Segment	Basin	Severity Index(2)		Pollution Control Programs(3)
1	Muddy Creek(4)	Missouri-Sun-Smith	81.24	A,B,C, D,F,G	2,6,7
2	High Ore Creek	Upper Missouri	38.18	A,B,F	1
3	Silver Bow Creek(4)	Upper Clark Fork	24.26	A,B,C,F	1,3,5,8
4	Prickly Pear Cr. below E. Helena(4)	Missouri-Sun-Smith	20.00	A,B,C, D,F,G	3,4,5,6,7
5	Spring Creek(4)	Missouri-Sun-Smith	18.22	A,B,C, D,F	1
6	Teton R. below Priest Butte Lakes(4)	Marias	8.45	A,B,F,G	6,7
7	Ashley Creek	Flathead	5.90	A,B,C, D,F	3,5
8	Beaver Cr. below Lake Bowdoin(4)	Milk	5.55	B,F	7
9	East Gallatin River(4)	Upper Missouri	5.49	B,F,G	3,4,5
10	Crow Creek	Lower Clark Fork	5.47	B,F	2,3,5,7
11	Camp Creek	Upper Missouri	5.20	B,F,G	2,5
12	Mission Creek	Lower Clark Fork	5.11	B,F	2,7
13	Spring Coulee	Marias	3.71	B	5
14	Sage Creek	Milk	3.58	B	2,6,9
15	Post Creek	Lower Clark Fork	3.14	B,F	2,7
16	Grasshopper Cr. below Bannack	Upper Missouri	2.92	B,G	1
17	Clark Fork R. from Warm Springs to Garrison(4)	Upper Clark Fork	2.41	A,B,C	1,3,4,5,8
18	Whitefish R. below Whitefish L.	Flathead	1.57	B,G	2,3,5
19	Jefferson River(4)	Upper Missouri	1.44	B,F,G	3,4,5,7
20	Clark Fork R. from Garrison to Bonner	Upper Clark Fork	1.28	B,C	3,4,5,8
21	Beaver Creek below Wibaux(4)	Little Missouri	1.06	B	3,5
22	Willow Creek	Marias	1.04	B	3,5

23	Yellowstone R. from Laurel to Custer(4)	Middle Yellowstone	0.98	B,C	3,5
24	Douglas Creek	Upper Clark Fork	0.91	B,F	5
25	Big Spring Creek(4)	Middle Missouri	0.89	B,D	3,5
26	Little Peoples Creek	Milk	0.86	B,D	5
27	Beaverhead R. below Dillon	Upper Missouri	0.66	B,G	3,4,5
28	Boulder River below Basin(4)	Upper Missouri	0.61	B,G	1,3,4,5
29	Madison River(4)	Upper Missouri	0.57	A,B,C,D, E,F,G	3,5,7
30	Bluewater Creek(4)	Upper Yellowstone	0.56	B,F,G	7
31	Belt Creek below Dry Fork	Missouri-Sun-Smith	0.43	B,F	1
32	Kootenai R. below Libby Dam	Kootenai	0.39	B,D,G	3,5

1-Problem segments are mapped in Figure 1.

2-Key to letter codes for qualitative factors:

A Downstream use(s) impaired
B Improved water quality attainable
C Large population affected
D Valued resource affected
E Interstate, national or international issue
F Local interest and involvement
G Unnatural flow fluctuation

3-Key to pollution control programs:

1 Abandoned Mine Land Program, DSL and OSM
2 Agricultural Conservation Program, ASCS and county committees
3 Construction Grants Program, DHES and EPA
4 Instream Flow Reservations, DHES and DFWP
5 MPDES Permits and Enforcement Program, DHES
6 Renewable Resource Development Program and Water Development Program, DNRC
7 Special water quality improvement projects
8 Superfund, EPA
9 Triangle Saline Seep Program, Triangle CD

4-Biological impairment confirmed by monitoring and intensive surveys

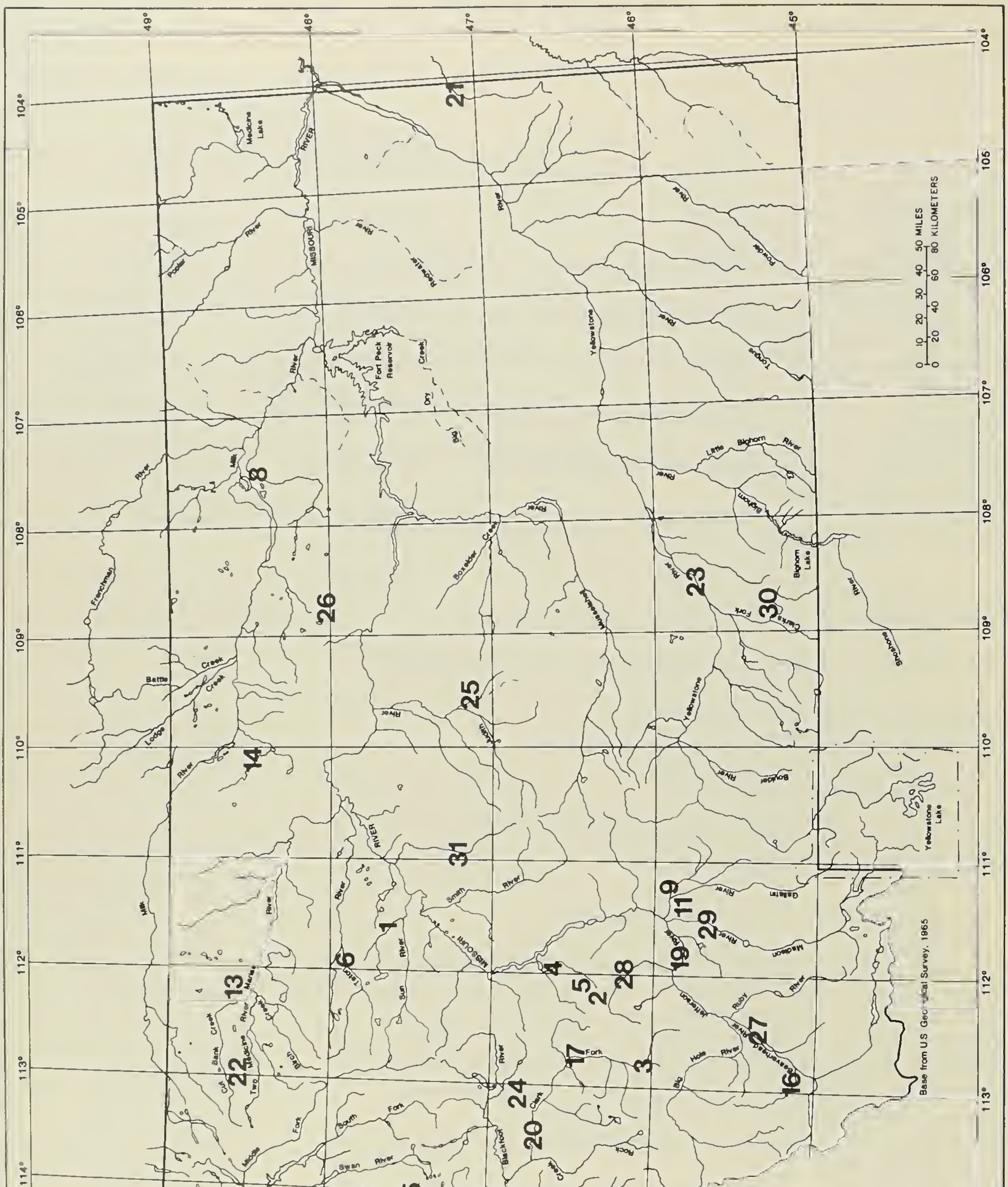


FIGURE 1. PRIORITY PROBLEM STREAM SEGMENTS.

Montana Travel Promotion Bureau

CONTROL EFFORTS

The problems in Table 2 are collectively being addressed by nine programs that could effect significant water quality improvements given adequate funding. These programs are:

Abandoned Mine Land (AML) Program

Funded by the U.S. Office of Surface Mining (OSM) and administered in Montana by the Department of State Lands (DSL), the AML program achieves reclamation of inactive mine areas that pose a threat to public health and safety. Seven problem segments in Table 2 plus one other—Soda Butte Creek—stand to be improved by AML projects in Montana, which are at various stages of implementation.

Agricultural Conservation Program (ACP)

On recommendation from county committees, the Agricultural Stabilization and Conservation Service (ASCS) provides cost-sharing to farmers for practices that conserve soil and water resources. For example, the program will share the cost of planting alfalfa and grass on saline seep recharge areas. Seven problems in Table 2 could be improved significantly by implementing conservation practices under the ACP.

Construction Grants Program

The EPA will share the cost of planning, design and construction of municipal wastewater treatment systems where upgrading is required to meet minimum treatment standards or where a public health or water quality problem exists. Responsibility for administering this program in Montana has been delegated to the WQB (see Control Programs). Active construction grants projects are on a majority of the 17 problem segments in Table 2 that are affected by municipal wastewater discharges.

Instream Flow Reservations

The 1973 Montana Water Use Act, administered by the Department of Natural Resources and Conservation (DNRC), provides for reservations of instream flows by public agencies for beneficial uses, which include water quality and fish habitat. In 1978, the DHES successfully defended a request for a flow reservation in the Yellowstone River for the purpose of holding down sulfate and salinity to levels suitable for human consumption. The DHES and the DFWP are preparing to apply for instream flow reservations in the Upper Missouri and Clark Fork river basins, which include six problem segments that could benefit from guaranteed minimum flows. In addition, DFWP is pursuing a plan with local irrigators and the U.S. Bureau of Reclamation to rewater the lower end of Prickly Pear Creek. If successful, it would permit upgrading the low classification of this severely polluted stream segment and, ultimately, its water quality.

MPDES Permits and Enforcement Program

The Montana Pollutant Discharge Elimination System (MPDES) is administered by the WQB for the purpose of permitting the discharge of pollutants from point sources into state waters. At least 17 of the problem segments in Table 2 are affected by point source discharges, mostly from municipal wastewater treatment plants that are in the process of upgrading their facilities and the quality of effluents. Where municipal effluents are concerned, the permits program works hand-in-hand with the construction grants program to ensure compliance with permit limits and water quality standards. Enforcement of water quality laws and rules applies to certain nonpoint source problems as well as to permitted and unpermitted discharges.

Renewable Resource Development (RRD) Program/Water Development Program

The RRD program began in 1975 when the legislature voted to use a portion of the state's coal severance tax to protect and develop Montana's renewable resources. The program provides grants and loans to agencies of state or local government for a variety of purposes, including soil and water conservation. The Water Development Program was created by the 1981 Legislature and funded by coal tax funds to help finance public and private water development projects and activities. Eligible projects include irrigation system repair, saline seep abatement, canal lining, streambank stabilization and erosion control. Both programs are administered by the DNRC. A number of current, special water quality improvement projects on problem segments in Table 2 have been funded by the RRD program.

Special Water Quality Improvement Projects

This is a catchall category of pollution control efforts at the local, problem-specific level. Included are groups like the Prickly Pear Task Force, the Flathead Areawide Planning Organization and certain county conservation districts. Two notable local programs on problem segments in Table 2 are the Muddy Creek Special Water Quality Project and the Madison River Thermal Project. Some of these local efforts are funded by the RRD program.

Superfund

The Superfund was set up by Congress and the EPA to finance the cleanup of hazardous waste disposal sites that pose a threat to public health. Seven sites in Montana have been selected by Governor Ted Schwinden as candidates for Superfund cleanup. Of these seven sites, four are on problem segments in Table 2. These four sites are: 1) the Anaconda Reduction Works, Anaconda, 2) Rocky Mountain Phosphate Company, Garrison, 3) Milltown area groundwater near Missoula and 4) Silver Bow Creek between Butte and Anaconda.

Triangle Saline Seep Program

The Triangle Conservation District (TCD), a consortium of 11 county conservation districts in the northcentral Montana "golden triangle" grain-growing area, sponsors a program that provides technical field assistance to landowners to correct and reclaim saline seep problems on a farm-by-farm basis. The headwaters region of Sage Creek has been targeted by the TCD for special effort because of its unusual concentration of saline seep problems and the high degree of landowner interest. The Triangle Saline Seep Program was awarded grants in 1979 and 1981 from the RRD Program.

LAKES

METHOD

A statewide inventory of lakes resulted in the creation of a computerized data base. Local fisheries biologists gathered information on more than 1,000 lakes. Geographic data were also obtained for about 500 of these lakes. Field work was performed on more than 30 lakes to obtain more detailed information. The relationships between nutritional status and physical and chemical parameters were investigated for these 30 lakes plus another 30 lakes already having detailed data.

After the information was compiled, data retrieval procedures were developed to list lakes in a variety of ways. These lists include lakes with low or high pH, low dissolved oxygen concentrations, high turbidity and eutrophic conditions. Based on these factors a list was prepared which contained all lakes which had one or more beneficial uses affected.

There is no way of judging the severity of the effect on beneficial uses because much of the compiled information is qualitative, for example an unexplained fish kill could be used as evidence of low dissolved oxygen concentration, and the data were not complete for all lakes. From the list of lakes in which one or more beneficial uses have been impaired, another list was made ranking the lakes by significance. Significance was based on ease of physical access, size (lakes less than 2 hectares (5 acres) surface area were not included), habitat for animals of special concern (rare, threatened or endangered), use as a drinking water supply, local importance and aesthetics. This resulted in a significance rating for 237 lakes. The 20 most significant lakes are listed in Table 3 and mapped in Figure 2.

CONTROL EFFORTS

One way to control water pollution in lakes will be to expand and complete the data base. Another way will be to give careful and rigorous review to proposed subdivisions, municipal effluents and industrial developments. Existing rules and laws, such as the Sanitation in Subdivisions Act, will be enforced to insure that lakes are not degraded by domestic wastes.

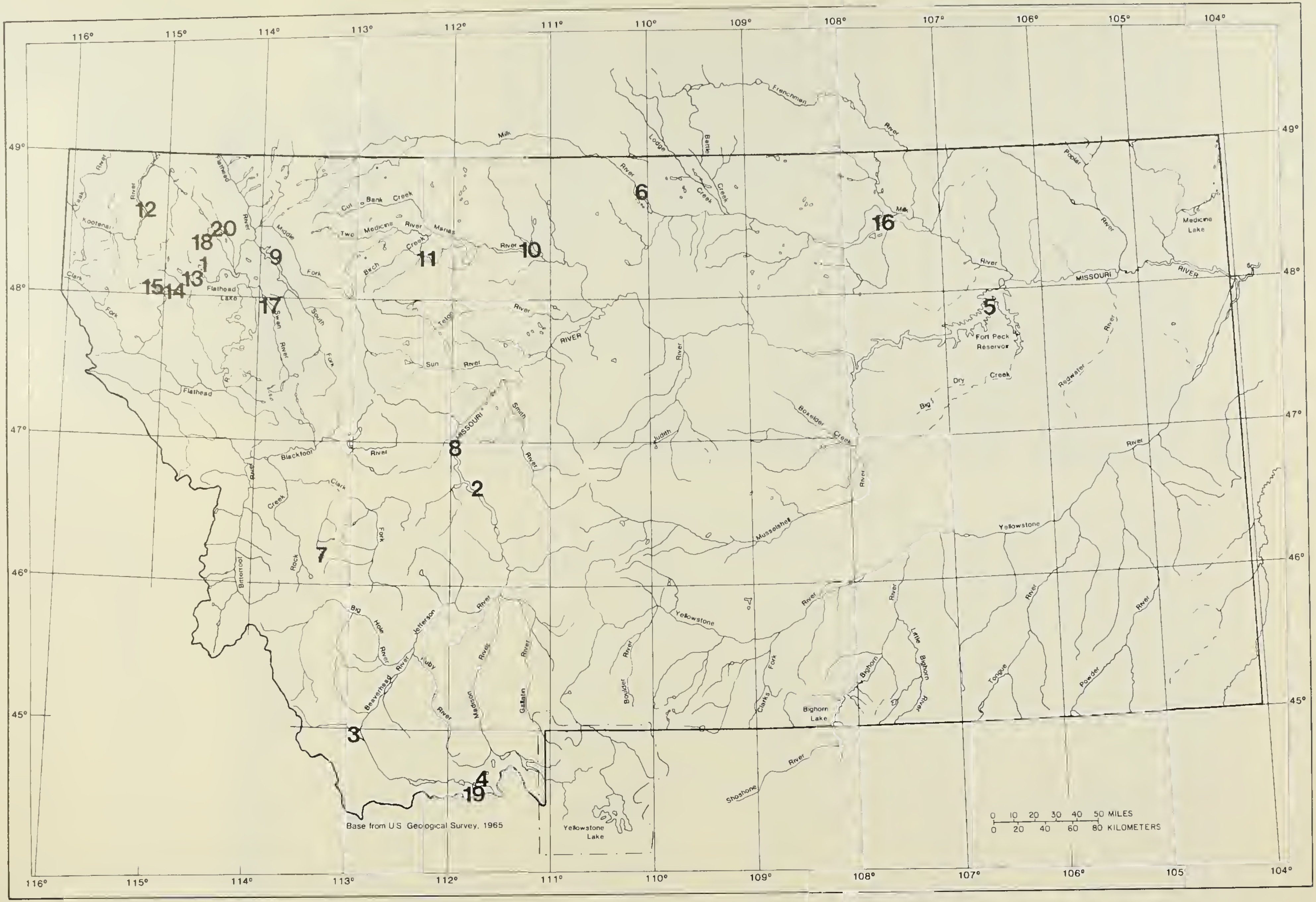
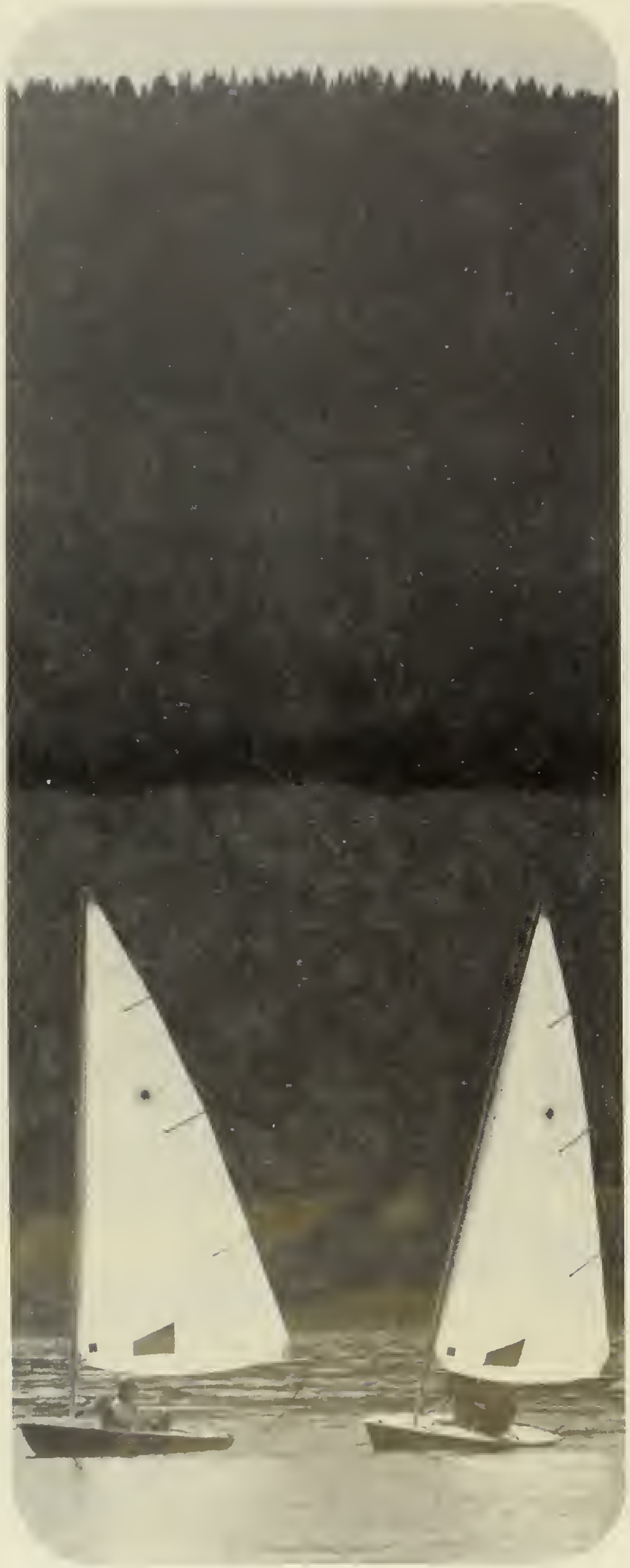


FIGURE 2. SIGNIFICANT LAKES WITH IMPAIRED USES.

Table 3. Twenty most significant lakes with affected uses.

Map Number (Fig. 2)	Lake	County	Significance Rating (1)
1	Ashley Lake	Flathead	36
2	Canyon Ferry Res.	Broadwater	37
3	Clark Canyon Res.	Beaverhead	37
4	Elk Lake	Beaverhead	34
5	Fort Peck Res.	Valley	48
6	Fresno Res.	Hill	34
7	Georgetown Lake	Granite	39
8	Holter Lake	Lewis & Clark	38
9	Hungry Horse Res.	Flathead	45
10	Lake Elwell	Liberty	37
11	Lake Frances	Pondera	42
12	Lake Koocanusa	Lincoln	38
13	Little Bitterroot Lake	Flathead	44
14	McGregor Lake	Flathead	33
15	Middle Thompson Lake	Lincoln	33
16	Nelson Res.	Phillips	36
17	Swan Lake	Lake	45
18	Tally Lake	Flathead	36
19	Upper Red Rock Lake	Beaverhead	36
20	Whitefish Lake	Flathead	45

(1) The higher the significance rating the more important is the lake based on the criteria given in the text.



Montana Travel Promotion Bureau

WETLANDS

Wetlands are areas inundated or saturated by surface or groundwater often enough and long enough to support vegetation typically adapted for life in saturated soil conditions. Wetlands include swamps, marshes, bogs and similar areas such as sloughs, potholes, wet meadows, river overflows, mud flats and natural ponds.

Wetlands in Montana provide habitat for wildlife, particularly migratory waterfowl. They also control floods by retaining water during periods of high runoff and then releasing it gradually. Many groundwater aquifers are fed by wetland recharge. Wetlands serve as nutrient traps, chemical sinks and sedimentation basins, thereby improving water quality.

The greatest concerns regarding wetland water quality are the haphazard use of pesticides and herbicides near wetlands and increasing salinity from poor agricultural practices. Livestock drinking from Montana wetlands have been poisoned by the toxic elements and salinity introduced by saline seeps. Elevated salinity levels in the Benton Lake National Wildlife Refuge near Great Falls have been coincident with an increase in botulism among refuge waterfowl. However, relatively little information is available regarding water quality in Montana wetlands.

This is probably because the principal use of wetlands is for wildlife habitat, and the water quality of most Montana wetlands generally does not impair this use. The actual loss or destruction of the wetland character is of greater concern than impairment of wetland water quality.

The U.S. Fish and Wildlife Service (USFWS) is now conducting a nationwide inventory of wetlands. This inventory will expand a brief, general survey done in the 1950's. The earlier survey was confined to the 15 Northern Montana or "Hi-line" counties and a portion of Lake County.

It estimated that the state contained 187,400 acres of wetlands, or approximately two tenths of one percent of the state's area. The latest National Wetlands Inventory is expected to provide greater detail and a more accurate assessment of the quantity and quality of wetlands in Montana. Maps will be prepared to show the location of wetlands. The inventory will classify each wetland according to the USFWS classification system. Only about two percent of the state has been mapped to date.

It is difficult to describe the quantity or quality of Montana's wetlands since the National Wetlands Inventory has not progressed very far. However, it appears wetlands are being lost to development. The actual rate and significance of the losses cannot be measured until the baseline information is gathered through the inventory.

State and federal agencies are involved in several programs and activities to protect Montana wetlands.

The U.S. Army Corps of Engineers administers the Dredge and Fill Permit Program in Montana under Section 404 of the Water Pollution Control Act. This program prevents the wanton destruction and filling of wetland areas in Montana. In addition, Executive Order 11990 requires all federal agencies to minimize destruction and loss of wetlands.

The USFWS, in addition to managing several wetland wildlife refuges, also administers a wetlands acquisition program whereby some important and threatened wetlands are acquired by means of easement or direct purchase. More than 22,000 acres have been acquired to date in 22 Montana counties through this program.

The ASCS of the U.S. Department of Agriculture administers the Water Bank Program whereby private landowners enter into 10-year agreements not to destroy selected wetland areas in return for annual payments. Nine counties (Daniels, Glacier, Lake, Pondera, Sheridan, Toole, Roosevelt, Flathead and Teton) offer or have offered Water Bank Agreements. Approximately 3,000 acres of Montana wetlands have been protected through this program.

The DFWP manages 45 wildlife management areas in the state. Nineteen of these areas contain wetlands. The DFWP also will be assisting the USFWS with the National Wetlands Inventory, particularly with verification and analysis of wetlands identified in aerial photos.

The Bureau of Land Management (BLM) of the U. S. Department of the Interior manages more than eight million acres of land in Montana. BLM estimates that its land contains approximately 33,000 acres of marshes, meadows and seeps, 143,000 acres of riparian areas and 15,600 acres of lakes and ponds. The BLM has filed for water rights on more than 4,300 pothole areas under their jurisdiction in northeastern Montana.

Finally in Montana, the Natural Streambed and Land Preservation Act requires permits from local conservation districts for stream construction activities. Unfortunately, these permits do not extend regulatory protection to wetland areas such as marshes, bogs, potholes and ponds.

GROUNDWATER

INTRODUCTION

Groundwater accounts for only about five percent of the water diverted in the state. Despite this small percentage, groundwater is often the only viable source of potable water.

Montana is generally divided into two separate regions, the Great Plains in the east and the Rocky Mountains in the west.

The Rocky Mountain Region is an area of rugged mountain ranges and intervening valleys. Folding, faulting and igneous activity produced these mountain ranges and valleys. Since the aquifers associated with geologic formations have been so changed, only the valley aquifers are generally suitable for groundwater development. These valley aquifers are composed of sediments derived from the surrounding mountains and serve as the primary groundwater source for almost all uses.

The stream-deposited valley sediments are composed of gravels, sands, silts and clays collectively called alluvium. Water availability from these alluvial deposits is variable and dependent on the character of the deposits. Streams are hydraulically connected to the alluvial aquifers creating a surface water/groundwater link. The alluvial aquifers generally have a dissolved solids content of around 350 milligrams per liter (mg/l). They are also vulnerable to contamination from agricultural practices, accidental spills, solid waste landfills and municipal and industrial discharges because of their shallow depths.

The other primary type of valley aquifer is that formed by the glacial deposition of sediment. These glacial aquifers range from a few to hundreds of feet thick, depending on location and mode of deposition. Water quality of glacial aquifers is generally very good, having an average dissolved solids content of 450 mg/l. Also, yields are generally very good. The glacial aquifers are less vulnerable to contamination than alluvial aquifers because recharge is dominantly from precipitation infiltrating from mountain ranges where there are fewer activities to cause contamination. But the aquifers are still vulnerable.

The Great Plains extends from the eastern base of the Rocky Mountains to the Montana-North Dakota border. The region is underlain by flat to gently dipping sedimentary rocks. The rocks that form the surface are generally soft and have been eroded into rolling plains.

Above the sedimentary formations are loose deposits that form alluvial aquifers. As in the Rocky Mountain Region, these alluvial aquifers produce more water than other aquifers in the plains region. They consist of sands, silts, gravels and clays situated adjacent to surface water systems. They are generally less than 30 feet thick, but may be 200 feet thick along major rivers. The quality of the water varies with the nature of the deposits. Water from alluvium normally ranges from 300 mg/l to 2,500 mg/l dissolved solids. Yields are generally good from these deposits. However, these aquifers are shallow and highly susceptible to contamination and overuse. Contamination can come from farming practices, accidental spills, solid waste landfills and pits, ponds and lagoons used for disposal of municipal, industrial or oil and gas wastes.

The Fort Union Formation is probably the most widely used aquifer in the Great Plains Region. This sedimentary formation is used more than other consolidated aquifers in the eastern third of the state primarily because it is closer to the surface. Generally the formation is less than 1,500 feet thick, but it is more than 8,000 feet thick in southeastern Montana. Groundwater is obtained mainly from sandstone and coal beds, and generally contains from about 500 mg/l to more than 5,000 mg/l of dissolved solids. Yields are typically less than 15 gallons per minute. Because of its location, the Fort Union Formation is particularly susceptible to contamination from oil, gas and coal mining activities. Because of its depth, it generally is not vulnerable to contamination from surface developments.

The Eagle Formation is one of the main aquifers in the northwestern Great Plains Region. The area in which this aquifer is used most corresponds to the area where the formation is less than 300 feet below the surface. The Eagle Formation is rarely more than 400 feet thick. Siltstone and shale are the dominant units. Even though the aquifer is available in the eastern part of the state, it is rarely used because of its low yields and poor quality. However, where it is used dissolved solids usually are less than 1,500 mg/l. Yields average less than 50 gallons per minute. The Eagle Formation is not very vulnerable to contamination because of its depth, and the fact that little oil, gas or coal mining occurs in the area underlain by this formation.

There are several other aquifers used to a small degree in the Great Plains Region, however, the three discussed— alluvial, Fort Union and Eagle—are the main drinking water aquifers.

GROUNDWATER USE

Accurate information on groundwater withdrawal rates is difficult to obtain. Municipal water systems maintain the best water use records, but in many instances only new delivery systems are equipped to measure discharge. Similarly, rural, agricultural and industrial users often have no means of measurement and only estimates can be made for their rate of use.

Major users of groundwater in Montana are farms and ranches that irrigate, municipalities, industries, rural households and livestock. Cumulative groundwater withdrawal is approximately 261 million gallons per day (mgd) or 800 acre-feet per day. This represents only two to three percent of the total amount of water diverted within the state. Even though current groundwater use is small, it is often the only viable source of potable water that can be developed.

Most of the wells in Montana are completed in alluvial aquifers and in the Eagle and Fort Union formations, although deeper aquifers are exploited locally. These principal aquifers are mapped in Figure 3. Table 4 shows estimated daily groundwater withdrawal rates by use categories. The population served by public water systems and by rural domestic wells and the number of acres of irrigated cropland are also shown in this table. The number of wells by county and by use in Montana are shown in Table 5. This table also shows municipal groundwater use and self-supplied industrial groundwater use by county. (Self-supplied industrial water is defined as that which is obtained directly by industry as opposed to that provided by a municipality.) Cities over 1,000 in population that are supplied by wells are mapped in Figure 4.

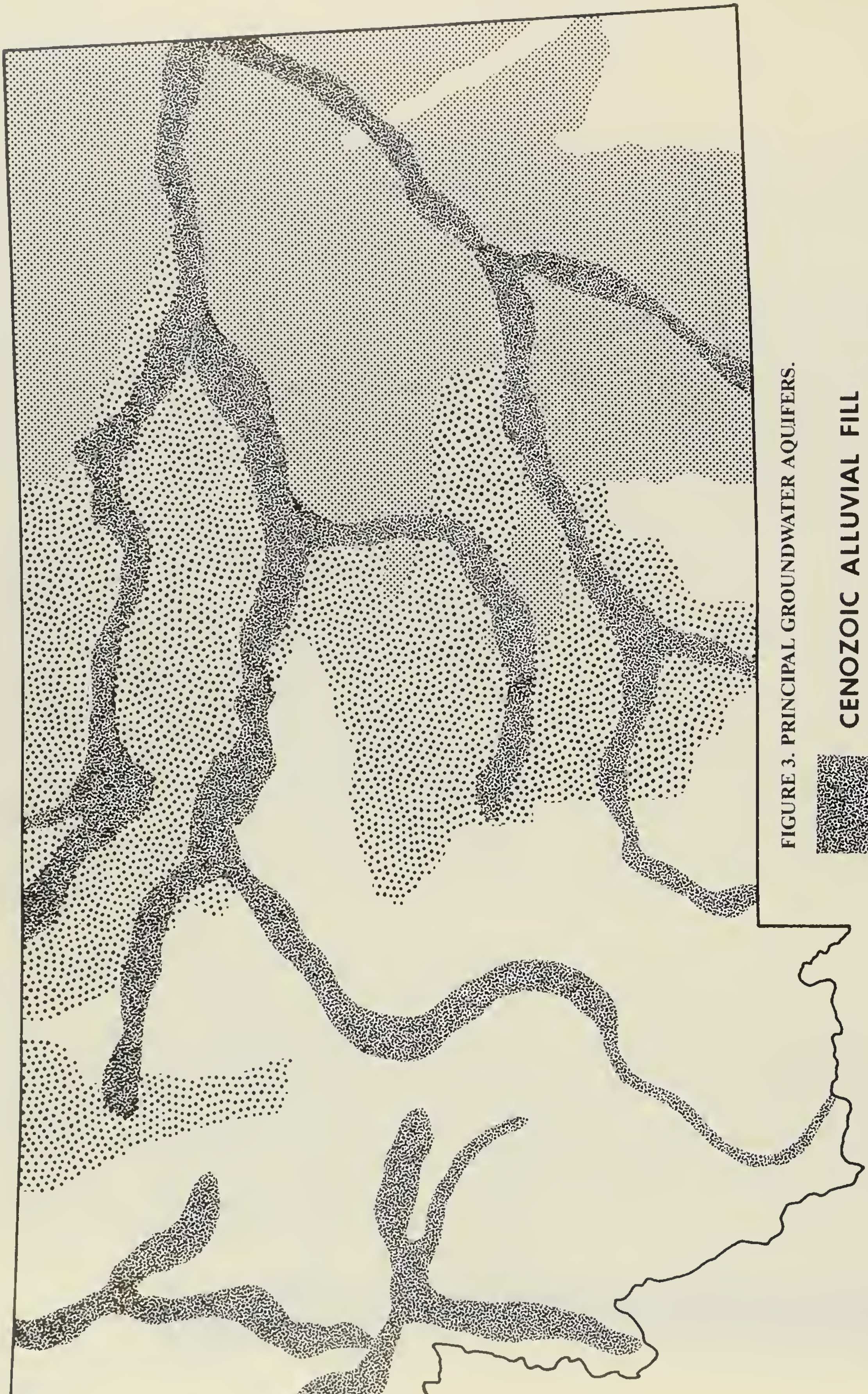


FIGURE 3. PRINCIPAL GROUNDWATER AQUIFERS.

CENOZOIC ALLUVIAL FILL

EAGLE FORMATION (Underlies Fort Union in east)

FORT UNION FORMATION

Table 4. Ground Water Withdrawal Rates.

	Public Water Supply Wells	Agricultural Wells (Irrigation & Livestock)	Rural Domestic Wells	Industrial Wells
Withdrawal Rate (mgd)	55	119	60	27
Population Served	185,000 or 24% of state population	--	262,500 or 34% of state population	
Irrigated Cropland (Millions of Acres)	--	2.59	---	---

Sources: Montana Department of Natural Resources and Conservation and United States Geological Survey

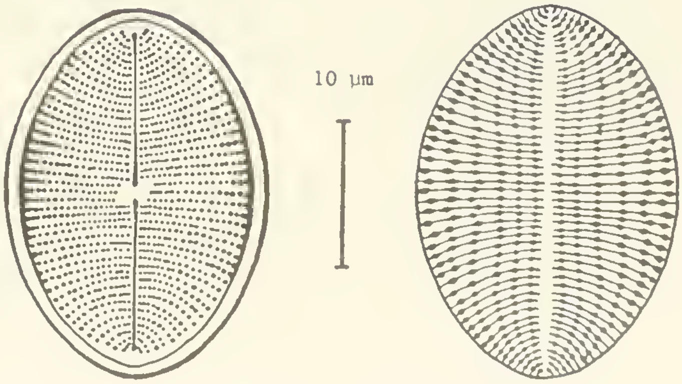


Table 5. Montana Wells by use and by county. *I--Municipal, II--Other Public (Subdivisions, Trailer Courts, etc.), III--Domestic, IV--Agricultural (Irrigation and Livestock), V--Industrial, VI--Other, VII--Total No. of Wells, VIII--Municipal Water Use (mgd), IX--Self-supplied Industrial Use (mgd).

	*I	II	III	IV	V	VI	VII	VIII	IX
Beaverhead	11	14	831	300	4	89	1249	0.52	0.08
Big Horn	3	10	379	384	18	93	887	0.26	
Blaine	1	8	342	397	6	32	786	0.04	
Broadwater	0	8	453	234	1	62	758	0.97	
Carbon	1	13	880	215	2	126	1237	0.59	
Carter	0	2	185	648	0	19	854	0.08	
Cascade	22	11	1321	247	5	116	1722	0.80	
Chouteau	0	28	491	344	0	121	984	0.26	
Custer	12	9	443	704	3	122	1293	0.20	
Daniels	1	6	261	193	2	91	554	0.25	
Dawson	13	14	700	710	17	123	1577	0.37	
Deer Lodge	3	4	591	39	6	38	681	4.15	
Fallon	0	7	297	571	8	42	925	0.42	
Fergus	1	7	725	459	13	165	1370	2.14	0.27
Flathead	19	34	3327	122	37	323	3862	3.60	4.57
Gallatin	15	27	2669	237	37	192	3158	1.92	0.56
Garfield	0	2	218	689	2	40	951	0.06	
Glacier	8	4	283	105	20	20	440	0.86	0.24
Golden Valley	0	0	165	279	0	20	464	0.01	
Granite	4	4	420	45	1	43	517	0	
Hill	0	21	664	238	9	99	1031	1.06	
Jefferson	1	25	646	100	6	70	848	1.67	0.21
Judith Basin	2	8	325	323	3	76	737	0.06	
Lake	2	20	1322	70	3	122	1539	0.66	
Lewis & Clark	10	36	2418	216	15	281	2976	1.57	0.08
Liberty	0	3	168	118	0	41	330	0.01	
Lincoln	11	15	1180	21	6	72	1305	0.78	0.08
McCone	2	7	300	496	0	46	851	0.12	
Madison	2	14	904	176	3	54	1153	0.19	
Meagher	0	5	150	54	2	33	244	0.06	
Mineral	5	8	235	12	3	32	295	0.34	2.31
Missoula	14	60	2646	94	65	304	3183	13.27	17.50
Musselshell	0	9	546	829	2	68	1454	0.91	
Park	1	11	747	90	9	103	961	2.55	
Petroleum	1	1	71	193	47	30	343	0.01	
Phillips	2	7	597	496	8	54	1164	0.39	
Pondera	0	13	184	85	0	28	310	0.12	
Powder River	1	9	442	1605	3	27	2087	0.25	
Powell	1	6	463	86	3	38	597	1.12	
Prairie	4	5	211	590	9	25	844	0	
Ravalli	10	30	3686	288	18	1033	5065	2.12	0.02
Richland	1	20	635	834	23	73	1586	1.45	
Roosevelt	1	10	405	372	13	67	868	1.06	0.03
Rosebud	0	21	316	672	17	62	1088	0.57	
Sanders	5	8	672	104	2	108	899	0.65	
Sheridan	0	12	336	190	6	49	593	0.65	
Silver Bow	5	4	610	56	10	47	732	0.02	0.78
Stillwater	3	6	668	401	5	71	1154	0.65	
Sweet Grass	0	2	341	180	2	34	559	0.31	
Teton	5	10	758	310	2	97	1172	1.03	
Toole	0	11	111	127	1	63	313	0.97	
Treasure	0	2	71	223	0	10	306	0	
Valley	0	24	708	574	6	149	1461	1.16	
Wheatland	1	2	121	396	2	36	458	0.13	0.06
Wibaux	0	7	239	410	2	36	694	0.06	
Yellowstone	4	18	2255	889	17	281	3464	0.84	0.28
TOTAL	208	682	41132	18731	485	5696	66934	54.57	26.97

Source: Water Resources Division, Department of Natural Resources and Conservation

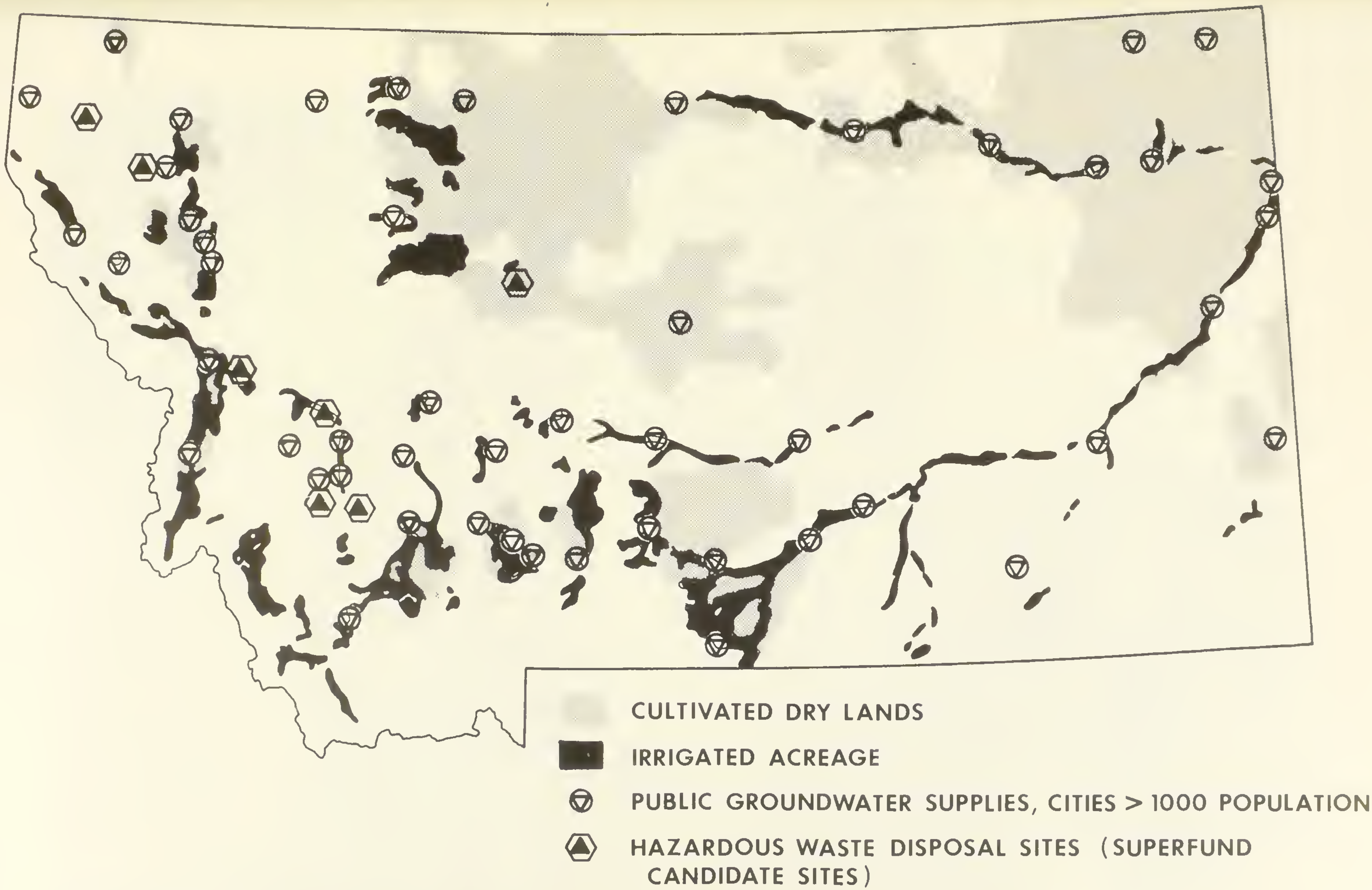
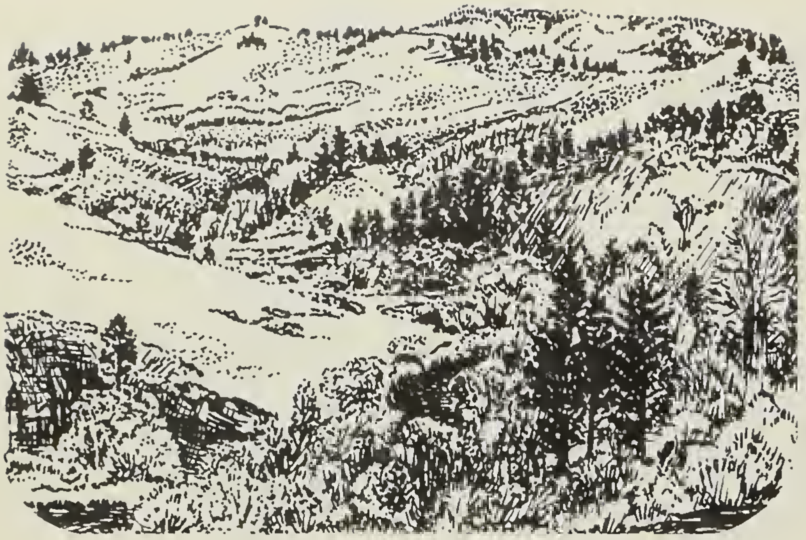


FIGURE 4. MAJOR POLLUTION SOURCES AND PUBLIC GROUNDWATER SUPPLIES.



PROBLEM DISCUSSION

Identifying and analyzing groundwater pollution is different from identifying and analyzing surface water problems. While a significant amount of groundwater quality information exists, the data base is not centralized nor is it organized in a manner which allows collation, analysis, identification and quantification of pollution problems and trends. The Montana Bureau of Mines and Geology is attempting to establish a statewide computerized data storage and retrieval system. The system, however, is not fully operational.

In addition, a comprehensive groundwater quality monitoring network has not been developed. Groundwater data are generally collected in response to specific problems. Statewide groundwater quality conditions and trends are, therefore, difficult to establish. It is generally believed that Montana does not have the threat of groundwater pollution that more industrialized states have. However, groundwater pollution has occurred.

SALINE SEEP

Saline seep poses the greatest threat to groundwater. It is caused by the dryland farming practice of summer fallowing. Natural vegetation is removed and excess soil moisture allowed to accumulate. Much of the land used for dryland farming is rich in natural salts, which are susceptible to leaching. The excess moisture moves through the soil, dissolving the salts and becoming increasingly saline. The salty solution can and does contaminate groundwater. Often the leached solution hits an impermeable geological formation, moves laterally downslope, and emerges at the surface where it forms the familiar saline seep. The moisture evaporates leaving a crust of salt.

Saline seep has caused great concern in the agricultural community due to the loss of productive land and salinization of freshwater reservoirs. Livestock can be poisoned from drinking this water. Also, farm and ranch families occasionally have had to abandon drinking water supplies that became too saline.

The pollution source map in Figure 4 shows the general areas where dryland farming occurs in Montana. Groundwater can be contaminated by saline seep in any area where dryland farming takes place. The severity varies. At its worst, groundwater can be severely degraded. Conductance levels from 2,000 to 15,000 micromhos/cm have been observed, as have sulfate levels of several thousand mg/l, and nitrate levels 10 times the drinking water standard of 10 mg/l.

Mismanagement of irrigation water can also cause saline seep. Areas of irrigated farming in Montana are shown in Figure 4.

U.S. Department of Interior

MINING

Groundwater pollution has occurred due to mining. Both abandoned and active mines can discharge highly acidic water causing degradation of groundwater. Contamination of surface waters from abandoned mining operations is well known, however, hidden pollution of alluvial aquifers with acids and heavy metals occurs in every instance of acid mine drainage to surface waters. While acid mine drainage is normally associated with metal mines in the mountains, acid mine drainage has also occurred in the Belt-Sand Coulee coal mining area southeast of Great Falls. Strip mining coal also can create serious groundwater problems. Areas where mining related groundwater pollution has occurred are described below:

*__Anaconda.__ Groundwater around the abandoned smelter is believed to be impacted by solid waste dumps. Studies are continuing. Seepage from Warm Springs and Opportunity tailings ponds may be occurring. There is no known use of groundwater.

Belt-Stockett-Sand Coulee. Acid mine drainage from abandoned coal mines is not believed to be affecting drinking water sources.

Basin Mining Area. Problems are occurring due to seepage from old tailings piles. No groundwater is being used, but impacts have been recorded on the following local streams: High Ore Creek, Basin Creek, Uncle Sam Gulch, Cataract Creek.

Cooke City. Abandoned mine tailings are contaminating springs with metals. The main impact is on Soda Butte Creek.

Colstrip. Active coal mining is occurring in the area. Studies show groundwater moving through spoils has elevated total dissolved solids, magnesium, calcium, sulfate, lead and nickel levels. There is a possibility the Fort Union aquifer, used for stock watering, might be impacted.

Columbus. The groundwater contains chromium from an old chrome ore processing waste pile.

Decker. This is an active coal mining area similar to Colstrip.

Hughesville. Metal contamination occurs in groundwater below the old tailings pond. There is no use of groundwater in the area.

Helena Mining Area. Cyanide was detected in water being pumped to supply the mill at the Franklin Mine. Cyanide in springs below the Goldsil mine tailings ponds have caused two fish kills in Silver Creek. Acid mine drainage has been recorded from abandoned mines and mine tailings long Spring Creek, Prickly Pear Creek and Ten Mile Creek. Groundwater contamination has occurred in the Spring Creek area.

*__Great Falls.__ Groundwater at the abandoned Anaconda copper and zinc refinery is laden with metals. Further studies are being carried out. There is no known use of groundwater.

Jardine. Arsenic has been found in groundwater near mining activities.

Philipsburg Mining Area. Mercury and heavy metals have been found in alluvial aquifers in mined areas in the Flint Creek Range.

*__Silver Bow Creek.__ The alluvial aquifer from the confluence of Copper Creek in Butte to the Warm Springs Ponds northeast of Anaconda has received industrial, municipal, agricultural and domestic wastes for more than 100 years. Contaminants include heavy metals and elemental phosphorus.

*Candidate sites for superfund cleanup (see pollution source map).

Coal seams, like those found in the Fort Union Formation in eastern Montana, can be important groundwater aquifers. Removal of these coal seams has affected groundwater availability in areas down gradient from strip mines. Studies have shown that groundwater moving through strip mined spoils developed elevated levels of total dissolved solids (TDS), magnesium (Mg), calcium (Ca), sulfate (S04), and heavy metals. Table 6 shows the average TDS levels in stock and domestic wells in the Fort Union Formation and in groundwater moving through mine spoils at Decker and Colstrip.

Table 6. Total dissolved solids (TDS) in wells and mine spoils of the Fort Union Region.

Area	Average TDS (mg/l)
Stock and Domestic Wells - Colstrip Area	1750
Rosebud Mine Spoils	2800
Big Sky Mine Spoils	3500
Stock and Domestic Wells - Decker Area	1750
Decker Mine Spoils	2400

Source: Montana Bureau of Mines and Geology

Department of Health and Environmental Sciences

ACCIDENTAL SPILLS AND LEAKAGE

Groundwater pollution has also occurred due to accidental spills of contaminants, and from leakage from underground storage tanks. Many spills are not documented, and their nature and severity is unknown.

Described below are recently documented spills and leakages of contaminants to groundwater. Many other instances of spills of pollutants to groundwaters are believed to have occurred. Most are probably minor and their cumulative impact is unknown.

Billings. Ethane, methane and small concentrations of oil and grease were found in shallow groundwater during a sewer dewatering project near Yegen Ditch. The source remains unknown. There is no known use of groundwater in the area.

Billings. Phenol contamination of groundwater allegedly exists at the Exxon refinery. An investigation is continuing.

***Bonner.** High arsenic levels were found in groundwater. Levels were ten times the drinking water standard of 0.05 mg/l. Some domestic wells were found to be contaminated. The source is unknown, and an investigation is continuing.

Bozeman. A gas station adjacent to Montana State University leaked gasoline into shallow groundwater. Gasoline was detected in a dormitory foundation drain. There is no known use of groundwater in the area. A similar gas leakage problem continues to plague domestic water supplies on the west edge of town. Surface and groundwaters have been contaminated with creosote and pentachlorophenol in the vicinity of Idaho Pole Company on the city's north side.

Broadus. Gasoline leaked into shallow groundwater. Twelve inches of gasoline were found to overlay a shallow water table. Gasoline fumes existed in the county courthouse and nearby businesses. No wells were known to be affected by this leakage.

Conrad. A gasoline station lost approximately 12,000 gallons of gasoline in 1975. Gasoline fumes were found in a nearby basement.

Deer Lodge. Gasoline odors were detected in the municipal water supply in 1972. Apparently the municipal well casing leaked gasoline into the supply. Several thousand gallons of diesel fuel were also accidentally spilled from a tank car in 1970 or 1971.

Dillon. Petroleum product odors have been detected in domestic wells near the site of a spill and a leak from a storage facility.

East Helena. Slag piles at the ASARCO refinery are believed to be leaching chemicals into groundwater.

Glendive. 18,000 gallons of diesel fuel were spilled on the ground in 1975. No detailed investigation of the spill was conducted.

Great Falls. Shallow groundwater near the Falls Chemical Plant has been shown to contain low levels of 2,4-D. There is no use of groundwater in the immediate area, but some trees have died around a nearby slough.

Helena. Diesel fuel leaked into shallow groundwater by the Burlington Northern railroad appeared in a Helena storm drain and was discharged into city storm water infiltration ponds. There is no known use of groundwater in the area.

***Kalispell.** Evergreen area groundwater is believed to be contaminated by multiple sources. Spills of glue wastes at Plum Creek Plywood are believed to contribute to the problem.

Laurel. Petroleum products exist in groundwater near the CENEX refinery.

Lewistown. Gasoline from a filling station leaked into shallow groundwater and surfaced in the basement of an apartment building resulting in the evacuation of the building. There is no known use of groundwater in the area.

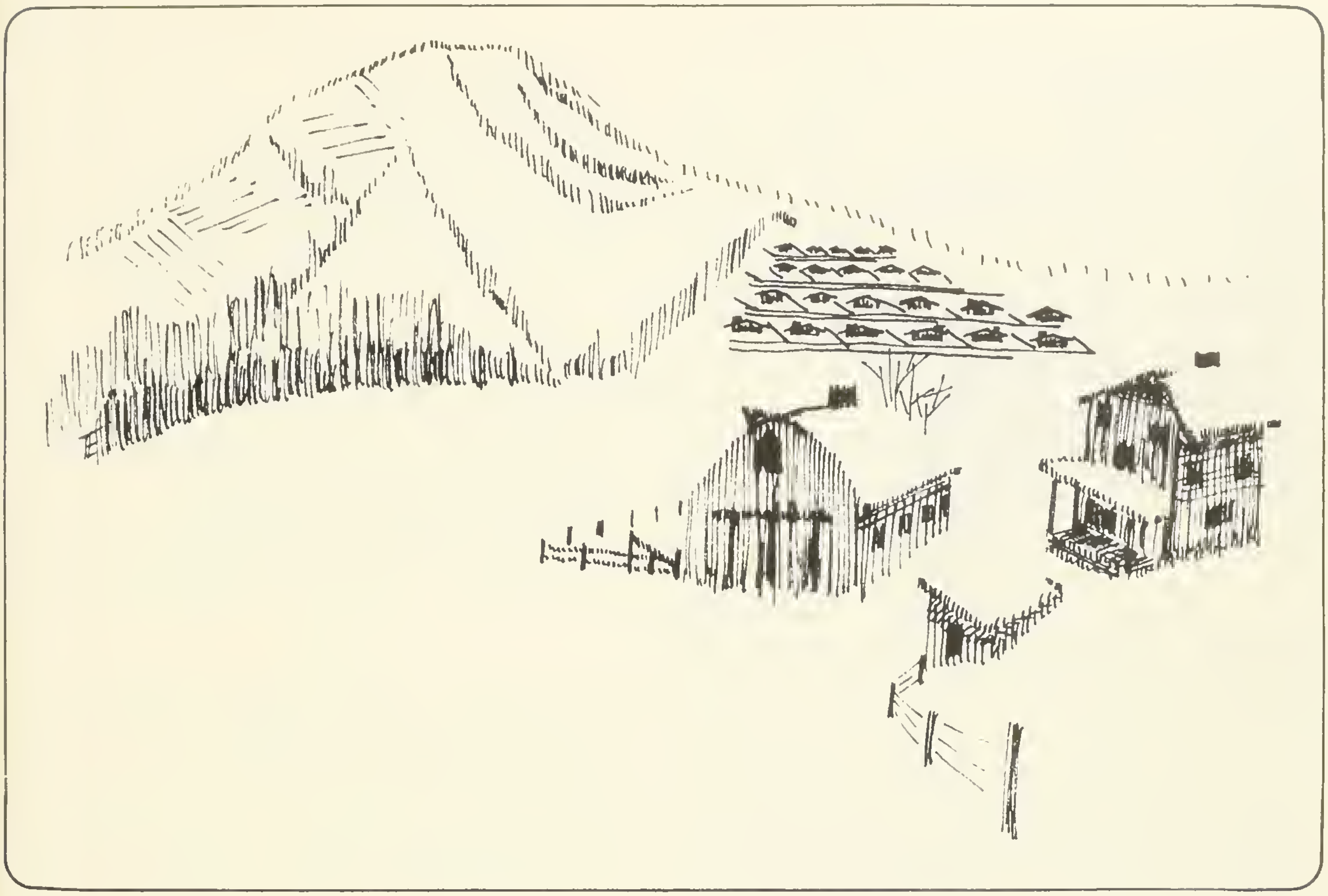
Libby. Elevated levels of pentachlorophenol were discovered in irrigation wells. They were believed to arise from spills during pole treatment at St. Regis Lumber.

Livingston. Diesel fuel was discovered in a groundwater drain that enters Sacajawea Lagoon.

Miles City. The Chicago-Milwaukee Railroad leaked diesel fuel into groundwater over many years. The railroad is recovering the fuel, about 350,000 gallons so far.

Missoula. A pressurized pipeline was discovered to be leaking in 1972. Approximately 126,000 gallons of gasoline were lost into the groundwater.

*Candidate sites for superfund cleanup (see Pollution source map).



SEPTIC TANKS AND DRAINFIELDS

Septic tanks and drainfields are often used for wastewater disposal in unsewered areas. It is generally believed that use of these systems is environmentally acceptable where drainfield sizing is proper and soils structure and groundwater depth are compatible. Subdivision regulations presently limit the use of septic tank-drainfield systems to lots of one acre or greater where individual water systems are to be used. The regulations require that the seasonal groundwater level must be more than six feet from the surface. State subdivision sanitation regulations were implemented in the early 1960's. Prior to that time there were no state regulations governing individual sewage disposal. Septic tank/drainfield systems are constructed without state review in subdivisions created prior to the regulations and in parcels that fall outside the definition of a subdivision.

County and other local health departments in most areas of the state have septic tank/drainfield regulations that also must be followed. Many of the local health departments contract with the DHES to provide review of minor subdivisions.

Infectious hepatitis outbreaks occurred in the 1960's and 1970's in an unsewered area south of Libby. It is believed these outbreaks were related to dense housing (lot size 1/4 acre), use of septic tank-drainfield systems in shallow groundwater areas and shallow drinking water wells. This appears to be one of the clearest cases of groundwater pollution caused by septic tanks and drainfields. Any area with shallow groundwater, confined aquifers, permeable soils or fractured bedrock and dense housing poses a groundwater pollution threat. Some of the areas with potential groundwater contamination problems are Kalispell-Evergreen, Helena Valley, South Libby Flats, Billings Heights, East Hamilton and Opportunity. Kalispell-Evergreen and South Libby Flats are candidate sites for superfund cleanup.

In addition, sewer systems have recently been or are being constructed in response to sewage disposal hazards in Plains, Troy, Corvallis, Lincoln, Geyser, Roy and Gildford.

OIL AND GAS EXPLORATION AND DEVELOPMENT ACTIVITY

Groundwater contamination can occur from several activities associated with oil and gas development. Water is used in drilling to lubricate the drill bit, for sealing purposes and to help bring drilled material to the surface. If low quality water, particularly a brine, is used, it can contaminate higher quality aquifers. In the past, brines were often used. Recent rules adopted by the Montana Board of Oil and Gas Conservation require the use of fresh water when drilling through potable aquifers.

Brine is often pumped with oil to the surface. These waters have TDS levels ranging from 10,000 to 300,000 mg/l, compared to sea water which has a TDS level of 35,000 mg/l. They are disposed of by reinjection or by discharging into evaporation pits. Failures in either production well or injection well casings can allow brines to escape into aquifers containing good quality water. Unlined evaporation pits can allow brine to seep into shallow groundwater. Spills of oil or brine at the surface can contaminate shallow groundwater.

In the past few years, rising energy prices have created the capital to encourage an increase in oil and gas development. Drilling has occurred in the Williston Basin in northeastern Montana (Fallon, Wibaux, Dawson, Richland, Roosevelt and Sheridan counties) and in the Cut Bank-Sweetgrass area.

Underground seismic testing has resulted in a concern for groundwater contamination. Shot holes are drilled less than 200 feet deep and explosives detonated during seismic testing. Each year thousands of seismic test holes are drilled throughout Montana. These shot holes create concern that shallow polluted groundwaters (perhaps influenced by saline seep) will contaminate deeper, higher quality aquifers. Seismic shot holes have been found to plug themselves naturally as they cave in. There is still concern, however, that they allow surface water to enter aquifers, thus mixing different aquifers. It is expected that state rules will be established requiring shot holes to be filled.

SOLID WASTE DISPOSAL LANDFILLS

Groundwater contamination from solid waste disposal sites can occur as groundwater moves laterally through buried wastes or as precipitation percolates down through waste. Prior to 1977, solid waste disposal sites or landfills were licensed by counties, but in 1977 the Montana Solid Waste Management Bureau was given authority to establish a statewide landfill review and licensing system. Before 1967 there were no landfill licensing or review requirements. Landfills established prior to 1967, and to a certain extent prior to state licensing in 1977, are more likely to pose a pollution threat to groundwater.

Prior to the licensing requirements, many communities did not thoroughly consider environmental consequences when siting refuse disposal areas. Landfills have been sited in drainage areas with permeable soils and shallow groundwater. Described below are landfill sites which threaten to contaminate groundwater. Many of the landfills have been closed or are expected to close. Monitoring programs are done on a case by case basis and are extremely limited by high costs. Other landfills undoubtedly pose a threat to groundwater quality; those described below appear to pose the greatest pollution hazards:

Old Livingston Landfill. This sanitary landfill, located approximately one mile northeast of Livingston adjacent to the Yellowstone River, has been closed. The landfill area is underlain by shallow groundwater. A portion of the landfill actually lies beneath the groundwater table. The groundwater at the site has elevated TDS, hardness, alkalinity, conductivity, chloride, potassium, total organic carbon (TOC) and chemical oxygen demand (COD). The groundwater in the general area is used for domestic, stock, irrigation and municipal purposes.

West Yellowstone Landfill. This landfill, located on Forest Service land north of West Yellowstone, has been demonstrated to pollute groundwater beneath the site with TDS, iron (Fe), manganese (Mn), lead (Pb) and carbon dioxide. A plume of contaminated leachate is believed to be moving toward the Madison River. There is no use of groundwater in the area. This landfill is expected to be closed.

Alder Dumpsite. High seasonal groundwater exists. No control has been exercised over disposal of septic tank pumpings or hazardous waste in the past. This dumpsite is expected to be closed.

Stanford Dumpsite. High groundwater levels exist at the site. A study of alternative refuse disposal options was recently completed, but the site will probably remain in use for some time.

Sheridan Dumpsite. High seasonal groundwater levels exist at the site. Negotiations on closing the landfill continue.

Sand Coulee Dumpsite. This dump is sited in an abandoned coal mining area with high groundwater. The dump has been closed and efforts are being initiated to "cap" the fill with less permeable cover materials.

Cascade Landfill. The landfill sits adjacent to the Missouri River in an area of high groundwater. This landfill is expected to close.

Helena Landfill. This landfill is situated in moderately permeable soils 30 feet above the groundwater table. It is suspected that a leachate plume with high levels of nitrate is migrating north. Studies are continuing.

Scratchgravel Landfill. The landfill is situated in permeable soils 35 to 60 feet above the groundwater. Samples indicate a leachate with high nitrate (15 mg/l) and high conductivity (1500 micromhos/cm). Studies are continuing.

Judith Gap Dumpsite. This open dump is located in a high groundwater area. Studies are continuing.

Anaconda Landfill. The landfill lies adjacent to Warm Springs Creek in an area of high groundwater. The landfill is still in use.

Plains Landfill. This landfill is located in a gravel pit with highly permeable soils. There is positive evidence that leachate is being found and a plume is probably moving toward the adjacent Clark's Fork River.

Butte Landfill. Samples have shown that groundwater is being contaminated, but the extent of the problem is unknown. Remedial efforts have been taken to minimize the problem. Studies are continuing.

Big Timber Landfill. It is strongly suspected that a leachate plume from the site may be flowing toward the Boulder River. Studies are continuing. The site is expected to close.

Cut Bank Landfill. This landfill is located in an area of high groundwater. The extent of contamination is unknown, but continued use of the site is expected.

MUNICIPAL/INDUSTRIAL WASTEWATER DISPOSAL

Many industrial and municipal wastewater disposal systems use facultative or aerobic lagoons or evaporation and seepage ponds. Wastewater percolating into the soil beneath these impoundments may pose a pollution threat.

An investigation completed in 1979 identified 676 surface wastewater impoundments in the state. The majority of these were less than 10 years old. Additional impoundments have been constructed in the last three years.

The impoundments in Montana range in size from 0.01 acre to about 700 acres. The largest are associated with mining and industrial operations and the smallest with oil and gas production and agricultural activities. Of the 676 impoundments, 154 were assessed for groundwater contamination potential. Only a small percentage were found to be lined or have groundwater monitoring wells.

Results of the groundwater contamination potential assessment indicated that: 1) Industrial and mining impoundments tend to be located on low ground near streams in alluvial sand and gravel, and where groundwater is moving toward the stream with no intervening water wells; 2) a very high proportion of oil and gas impoundments are located far from large streams and groundwater aquifers; 3) a large proportion of other impoundments tend to be located on alluvium along the major river valleys; 4) most of the impoundments are associated with water that is a current drinking water source, and 5) most of the wastewater that is put into the impoundments has low to medium health hazard potential.

There are localized impacts at some surface impoundments. For instance, the Champion pulp mill ponds northwest of Missoula introduce organic contaminants, measured as biochemical oxygen demand (BOD) and color, to the Clark Fork River alluvial aquifer. It is also believed that the extensive tailings ponds at Warm Springs and Opportunity, associated with the abandoned Anaconda smelter, contribute heavy metals and dissolved solids to the local groundwaters. However, the conclusions of the study were that surface wastewater impoundments on a statewide basis had minimal impact on the quality of groundwater in Montana.

Recently, more attention has been given to land application of wastes, particularly municipal wastewaters. The intent is to use the nutrients in wastewater as fertilizer, thereby eliminating or reducing surface water pollutants and achieving a higher level of wastewater treatment. Improper design or excessive land application rates, however, can cause groundwater quality problems. The communities in Montana that are using these resources, either through spray irrigation or rapid infiltration, or by spreading or injecting sludge, are identified in Table 7. Generally wastewater spray irrigation or sludge injection systems are designed so application rates of nutrients are balanced with accompanying crop uptake rates. Under this scheme heavy metal application rates are far below allowable limits.

Table 7. Facilities using land application of wastewater or sludge.

Location	Brief Description
Basin	Rapid Infiltration
Big Mountain	Spray Irrigation
Big Sky	Spray Irrigation
Bozeman	*Seasonal Rapid Infiltration Sludge Injection
Bucks T-4	Spray Irrigation
Butte	Sludge Disposal by Injection at Rocker
Columbia Falls	Sludge Injection
Corvallis	Rapid Infiltration
East Glacier	*Rapid Infiltration
Eureka	Spray Irrigation
Fairmont Hot Springs	Spray Irrigation
Geyser	*Spray Irrigation
Gildford	Complete Retention
Helena	Sludge Injection
Kalispell	Sludge Injection
Lincoln	*Rapid Infiltration
Many Glacier	Rapid Infiltration
Moore	*Spray Irrigation
Plains	*Rapid Infiltration
Roberts	Spray Irrigation
Roy	*Spray Irrigation
St. Mary (Glacier Park)	*Rapid Infiltration
St. Mary Resort	Spray Irrigation
Sidney	Rapid Infiltration
Stevensville	Partial Rapid Infiltration
Superior	Partial Rapid Infiltration
Three Forks	*Rapid Infiltration
Victor	Rapid Infiltration
Willow Creek	*Sludge Spreading

*under construction

CONTROL PROGRAMS

From the listing of known incidents of groundwater pollution, it appears Montana is fortunate that no major drinking water supplies are extensively polluted. The incidents listed should be regarded seriously since they represent the fragility of the resource and pose potential problems to drinking water supplies. Part of the reason there have not been more documented cases of pollution of groundwater used for drinking may be due to the state's sparse population.

A perpetual program to protect groundwater is necessary. As the state develops energy, mineral, oil, and other resources, more potential will develop for pollution of groundwater. Experience indicates that if there is a potential for pollution, some control will be needed to protect shallow groundwater resources. These are most easily developed for domestic purposes and also prove to be the most vulnerable to pollution from waste disposal or other surface activities.

In the past two years interest in resource development has substantially increased, prompting greater efforts to guard against groundwater degradation near proposed projects. For example, the review of plans for cyanide leach pads, tailings ponds and ponds used in the processing of ore has demanded a significant amount of the WQB staff time. These reviews have been accomplished with no increase in staff. The number of review requests has been so great, it has been difficult for the WQB to thoroughly investigate all applications.

Although tailings pond reviews for groundwater problems are consuming the WQB staff time, the greatest number of groundwater point-source pollution problems has been from gasoline and diesel fuel leaks and spills. The high incidence of this type of problem may be due to the fact that these products are generally located near more populous areas where they are more likely discovered and documented.

Since there are no regulations to directly prevent polluting state groundwater, the WQB has been using the Montana Water Quality Act to deal with groundwater problems and the Surface Water Quality Standards to indirectly address potential groundwater pollution problems.

For the past several years the WQB has been preparing groundwater regulations. The efforts to get the proposed regulations approved were recently motivated by requests to the Montana Board of Health and Environmental Sciences (BHES) from the Stillwater Protective Association and the Northern Plains Resources Council.

The BHES held a public hearing on the draft groundwater protection regulations on July 9, 1982, and plans to finish reviewing the regulations by September 1982. The biggest concern is how the WQB can actively implement the new regulations given current staffing limitations. The time required to administer the regulations can only increase as more developments occur.

special problems

Montana's "Big Three" water quality problems are sediment, salinity and water depletion. They are responsible for most of the pollution problems listed in the Appendix and are, for the most part, the consequence of intensive agricultural practices on an erosive, salt-rich and sometimes water-poor landscape. Collectively, they account for more than 4,000 miles of degraded streams. They have been with us for a long time and, unfortunately, will be with us for a long time to come.

There are also other major problems. Acid-mine drainage has affected many western mountain streams since the days Montana first became known as the "Treasure State." Careless disposal of toxic and hazardous wastes, much of these from the early mining industry, threaten water quality and public health. Historic overcutting and natural deforestation of some timbered watersheds have caused severe erosion, sedimentation and hydrologic instability.

Some of the more serious problems—like saline seep—have been discussed.

Rather than belabor the state's all too obvious water quality problems, the WQB discusses here what it believes will be the water quality issues of the future: acid deposition, ammonia, energy development, placer mining and toxics.

ACID DEPOSITION

Deposition of acid from precipitation and dry fallout is causing damage to water resources in parts of the eastern United States. Such damage has not been documented in Montana. However, it is possible that acid deposition has or might cause damage to water resources in Montana since the two elements necessary for damage are present.

Streams and small lakes with a low buffering capacity, the first necessary element, are present in the northwestern and southcentral mountains. The statewide lake inventory includes at least 75 lakes having an alkalinity of 15 mg/l calcium carbonate or less. However, fewer than half of the 1,000 lakes in the inventory have been sampled for alkalinity and many Montana lakes have not been inventoried. Alkalinity is a measure of a water's capacity to neutralize acid, and 15 mg/l is a very low amount.

The second necessary element is acidic rain, snow or dry fallout. For the last two years the pH of snow samples taken in most of the western half of the state has ranged from 5.0 to 6.0. However, in the southwest corner of the state the snow pH's have consistently been in the 4.0 to 5.0 range, which is more acidic. The pH of dry fallout and rain have not been determined throughout this area.

A committee has been set up by federal and state resource management agencies to coordinate information gathering and exchange data on acid deposition in Montana. However, there are no plans to expand sampling and snow sampling might be discontinued due to funding limitations.

AMMONIA

Modern wastewater treatment plants do a good job of removing pathogenic organisms and oxygen-consuming organic matter from raw wastewater, but they often don't completely remove one of the most toxic chemicals—ammonia. If water level in the stream receiving the treatment plant effluent is low, ammonia can be lethal to fish and other aquatic life.

Removing ammonia from wastewater effluents is expensive, and determining the ammonia tolerance levels for fish and aquatic life can be tricky. The toxicity of ammonia at any given time is a function of pH, temperature and a host of other environmental variables. Some aquatic organisms are more sensitive to ammonia than others. Also, a species may be more sensitive to ammonia at certain stages of development. Concentrations that don't kill aquatic life outright may impair reproduction and other biological functions. Other pollutants in treated wastewater are also toxic to fish and aquatic life. These may aggravate and mask the effects of ammonia.

For the past several years, the WQB has been reviewing ammonia discharges from municipal wastewater treatment plants. In most cases there was insufficient information on the quality of the water receiving the effluent to assess instream impact, hence the review has been slow. A combination of municipal discharge permit self-monitoring data, instream surveys and on-site laboratory bioassays were used to assess real or potential toxicity to aquatic life.

In the last water quality report, the WQB listed 36 municipalities and stream segments having potential ammonia problems. Knowledge gained from intensive surveys has eliminated 28 of these segments as potential problems, including the Clark Fork River below Missoula. This information saved the City of Missoula and federal taxpayers several million dollars which would have otherwise been used for ammonia treatment facilities.

The East Gallatin River was found to have an ammonia problem below the discharge from the Bozeman wastewater treatment plant, but infiltration beds and other plant improvements now under construction should correct the situation. Wastewater storage ponds initially included in the plant design for ammonia removal proved to be unnecessary.

Ammonia data from the Yellowstone River passing through Billings are now being analyzed by the WQB. The ammonia situation remains unresolved. The Yegen industrial drain continues to be a significant source of ammonia in the Billings area. Data from Ashley Creek below Kalispell are also being reviewed by the WQB. Lewistown (Big Spring Creek) and Ronan (Crow Creek) are also unresolved at this time. Browning (Willow Creek) and Wibaux (Beaver Creek) most likely have problems that will need correction; however, follow-up surveys will be required to determine their severity. An ammonia problem has been documented in Prickly Pear Creek below Helena, but it cannot be corrected until this stream's dewatering problems are solved and its classification is upgraded.

Ammonia intensive surveys are scheduled this year for Browning, Lewistown, Ronan and Wibaux. Although the status of these problems soon will be resolved, the issue of ammonia toxicity will remain indefinitely. Environmental benefits and the economic costs of advanced wastewater treatment must be weighed carefully. Growing community populations will eventually overload the ammonia removal capacity of some wastewater treatment plants.

ENERGY DEVELOPMENT

Montana and other western states contain much of this nation's energy reserves. The exploration, development and production of energy, while being necessary, poses a significant threat to quality of life and the environment. The impact of this development on Montana's water resources is of particular concern.

Major Montana energy resources likely to be developed are coal, oil, gas, hydropower and uranium. Also the state recently has been instrumental in developing wind energy near Livingston. However, it is expected that coal, oil, gas and hydropower will be the major focus of future energy development.

The type, location and extent of Montana's energy resource development, and the subsequent impact on water quality, will be examined in this section.

COAL

It has been estimated that Montana contains approximately 30 percent of the nation's known coal reserves. Forty-three billion tons of economically strippable coal are said to be available.

Most coal is obtained from strip mining. In eastern Montana, particularly Big Horn and Rosebud counties, coal is found in the Fort Union formation.

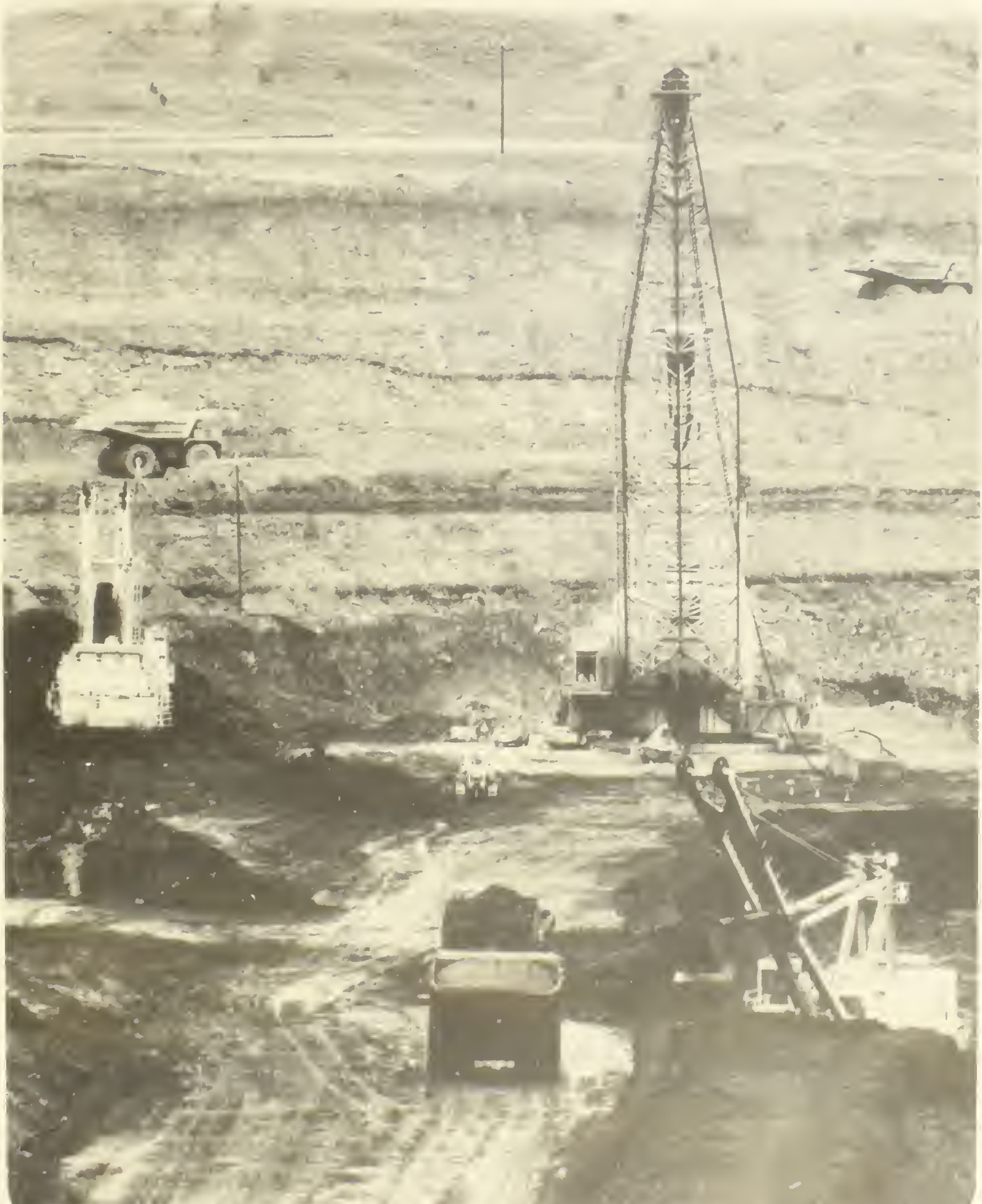
This geologic formation also serves as an important groundwater aquifer for domestic, stock and wildlife use. As the coal is removed, the groundwater flow is interrupted and modified, and water quality changes. Springs, seeps and shallow wells in mining areas often dry up, and the groundwater supply to local streams is reduced. This impact is generally limited to within a few miles of mining operations.

The mine spoils or overburden are usually placed in the mined-out coal bed during reclamation. The groundwater moving through a coal bearing aquifer changes in quality when the coal is removed and spoils replace the coal. This occurs because the the spoils contain significant quantities of leachable salts and minerals that readily dissolve in the groundwater. Thus, groundwater aquifers in coal areas show increases in dissolved solids following mining.

Total dissolved solids levels of approximately 1,750 mg/l exist in stock and domestic wells in the Colstrip and Decker areas. Total dissolved solids of approximately 2,400-3,600 mg/l were reported in the same general aquifers down gradient from mined areas. The solution rate in the spoils tends to decrease as water moves through it. However, with the low precipitation in eastern Montana, it may take many years, possibly centuries, before groundwater quality approaches premined conditions.

Where spoils aquifers discharge into streams, the increased salt load from leaching can add significantly to the salinity of the stream. Most of the discharge from spoils aquifers occurs as small springs and seeps to intermittent streams, which delays the effect of the discharge on water quality in perennial streams. One USGS study estimated that Tongue River salinity would increase 4 to 5 percent following the strip mining of 120,000 acres of federal land in southeastern Montana.

The vegetation disturbance associated with coal mining also increases the possibilities of erosion and stream sedimentation. Some of the sediment in Armells Creek in the Colstrip area may result from coal mining activities.



Willaim H. Birchard

Acid mine drainage is not a problem in the Fort Union Region due to the low sulfur content of the coal.

Montana has several large coal mines presently in operation. The largest mines are near Decker in Big Horn County and Colstrip in Rosebud County. Montana's existing coal mines and their production levels are shown in Table 8. In addition to these mines there are several new or expanded coal mining operations. The anticipated new coal mines in Montana (as of April 1982) are shown in Table 9.

A particular concern regarding coal development is Sage Creek Ltd., which plans to open a strip mine in Canada northwest of Glacier National Park. The proposed 2.5 million tons/year operation would be in the drainage of the North Fork of the Flathead River. Water quality impacts, particularly those resulting from sedimentation, are a major concern. The mine would disturb more than 2,000 hectares (5,000 acres) of land. The North Fork of the Flathead River flows southward out of Canada, forms the western boundary of Glacier National Park and drains into Flathead Lake. Increased sedimentation and nutrient enrichment in the North Fork could significantly degrade the mainstem and Flathead Lake. The North Fork and its tributaries serve as important spawning grounds for fish from Flathead Lake.

In addition to the coal mining, Montana water quality may be degraded by the development of coal-fired power plants or coal gasification/liquefaction plants. This type of industrial development has potentially greater water resource impact than coal mining. Significant volumes of process and cooling water are often required. The diversion of this additional water, and the discharge of wastewaters pose potential threats to Montana water quality. Tables 10 and 11 identify potential coal related industrial developments in Montana.

Table 8. Existing coal mines.

Mine	County	Company	Production (Million tons per year)
West Decker	Big Horn	Decker Coal Co.	5.5
East Decker	Big Horn	Decker Coal Co.	5.5
Spring Creek	Big Horn	Spring Creek Coal Co.	7
Absaloka	Big Horn	Westmoreland Resources	5
Area A	Rosebud	Western Energy	
Area B	Rosebud	Western Energy	10.5
Area E	Rosebud	Western Energy	
Big Sky	Rosebud	Peabody Coal Co.	4
Savage	Richland	Knife River Coal Co.	0.3
Divide	Musselshell		0.009
PM	Musselshell		0.011
Coal Creek*	Powder River		0.7
Beartooth	Carbon		0
Blackjack	Blaine		0.0005
Hathaway	Custer		0

*Closing in 1982 due to poor market conditions

Source: Strip Mining Bureau, Department of State Lands

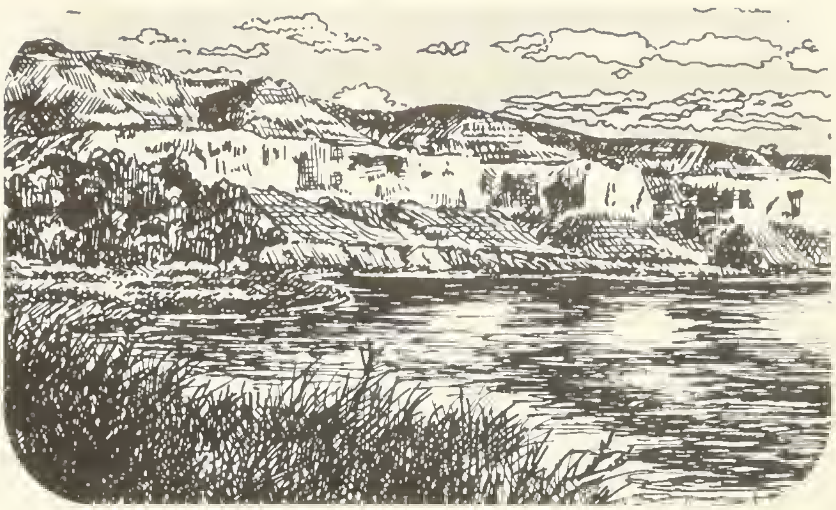


Table 9. Anticipated new coal mines

Mine	County	Company	Planned Production (Million tons per year)	Startup Date
Youngs Creek	Big Horn (Crow Indian Reservation)	Shell Oil Co.	up to 18 in 1998	1987
Nance	Rosebud	MONTCO	12	1983
Circle West	McCone	Burlington Northern	6	?
CX Ranch	Big Horn	CONSOL	4	1984
Squirrel Creek	Big Horn	Peter Kiewit Sons	4	1984
Area C	Rosebud	Western Energy	4	?
Area D	Rosebud	Western Energy	4	?
Absaloka (expansion of existing mine)	Big Horn	Westmoreland Resources	?	1982
North Decker (expansion of east and west Decker operations)	Big Horn	Decker Coal Co.	?	1982
Area B (expansion of existing mine)	Rosebud	Western Energy	?	1983
Area A (expansion of existing mine)	Rosebud	Western Energy	?	1983

Source: Strip Mining Bureau, Department of State Lands

Table 10. Potential coal gasification/liquefaction plants.

Company	County	Description
Tenneco	Wibaux	Coal gasification
Washington Energy	McCone	Coal gasification
Utah International	Powder River	Coal gasification
Meridion Land and Minerals	McCone	Ammonia, methanol, and diesel fuel production from coal
Mobile Oil	Dawson	Coal liquefaction to gasoline
Farmers Potash	Daniels	Mining potash to produce fertilizer using coal as energy source
Crow Indians/ Fluor Corp.	Big Horn	Coal liquefaction

Source: Facility Siting Division, Department of Natural Resources and Conservation.

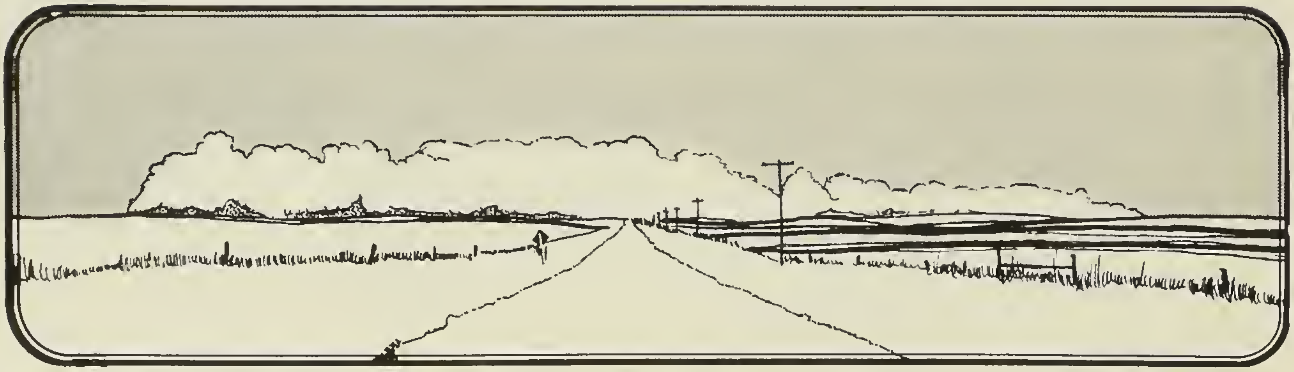


Table 11. Potential electric generating plants.

Company	Size	Location
Montana Power Co. (Salem Project)	2-350 MW	Great Falls
Crow Indians/ Fluor Corp.	500 MW	Crow Indian Reservation

Sources: Facility Siting Division, Department of Natural Resources and Conservation

OIL AND GAS

Oil and gas exploration and development can adversely alter water quality. The greatest concerns are associated with groundwater. During seismic exploration the shock from underground explosions can alter aquifers by affecting yield and water quality. Penetration of several geological formations during drilling can allow mixing between previously isolated groundwater aquifers. High quality aquifers can be degraded by the introduction of water from low quality aquifers. Improper well casing or failure to plug abandoned wells can also cause groundwater contamination. In addition, groundwater from the deep aquifers is often pumped to the surface along with hydrocarbons. This water is often brackish or saline and can pose a pollution hazard if not properly handled. These salty waters should be disposed of by reinjecting into deep aquifers or by discharging into evaporation pits. Indiscriminate dumping can destroy crop and range lands, pollute stock ponds, and contaminate groundwater supplies. Cracked casings in reinjection wells can allow the brackish water to pollute shallow, higher quality aquifers.

Sedimentation in surface waters can also occur whenever vegetation is disturbed. Construction of access roads, clearing of drilling areas, and installation of pipelines, storage tanks and production facilities all increase erosion and sediment production. When mud pits are used at drilling sites there is a potential for overfilling and dike failure. If this happens, drilling fluids can be released causing erosion and contamination of streams.

Population growth and related development also affect water quality. Overloaded sewage treatment facilities are one result of "boom town" development. Residential construction for oil field workers can increase sediment yield.

State and federal regulations govern the amount of earthmoving work, the disposal of wastewater and the plugging of abandoned wells. The Federal Safe Drinking Water Act authorized a permit program to control the underground injection of oil field wastes. The EPA intends to implement such a program in Montana in 1982.

Oil and gas development is increasing in Montana. In the last several years, rising prices have prompted petroleum companies to explore previously untapped geological formations and "frontier" areas. This is illustrated by Table 12, which shows the total number of exploratory and developed oil and gas wells in Montana from 1976 through 1981. The table also shows the average price of oil obtained by Montana producers during this period. Significant increases in drilling activity are anticipated.

There were more than 4,000 producing oil and gas wells in Montana at the end of 1981. Approximately 85 percent of these wells were in northern Montana and the Williston Basin of eastern Montana.

Portions of the western third of Montana are part of the Overthrust Belt, a region where older mountain rocks have been thrust hundreds of miles eastward over the younger strata of the plains. The Overthrust Belt has yielded significant quantities of hydrocarbons in both Alberta and Wyoming. Only recently have exploration and development activities begun in Montana's Overthrust Belt. Thousands of acres of private lands in the Flathead, Mission, Blackfoot, Missoula, Bitterroot, Deer Lodge and Big Hole valleys have been leased.


OIL WELL

Federal lands comprise the majority of land in Montana's Overthrust Belt. Table 13 shows the number of acres leased for oil and gas development as well as the number of acres for which lease applications are pending with the U.S. Forest Service (USFS) in Montana. Review of this table shows an increasing interest in oil and gas development in the Flathead, Beaverhead, Lewis and Clark, Bitterroot and Lolo national forests. This corresponds directly to interest in Montana's Overthrust Belt.

Development of oil and gas in western Montana poses special problems for water resources. Earthmoving, road building and related activity can result in severe erosion and sedimentation in mountainous areas. Geological formations are generally more fractured than those in the plains, hence drilling activity in the mountains is potentially more hazardous to groundwater resources.

Existing water quality in western Montana is generally very good; therefore, these waters stand to lose a lot. Protection of the high quality waters in Montana's Overthrust Belt as oil and gas resources are developed will require the work and cooperation of government agencies and oil and gas producers.

Table 12. Oil and gas drilling activity.

Year	Total Wells Drilled	Average Price Oil per Barrel
1976	787	$ 8.42
1977	678	8.64
1978	793	9.25
1979	803	12.39
1980	952	22.25
1981	1149	32-35

Source: Oil and Gas Conservation Division, Department of Natural Resources and Conservation.

Table 13. Acres leased for oil and gas development on Montana national forests.

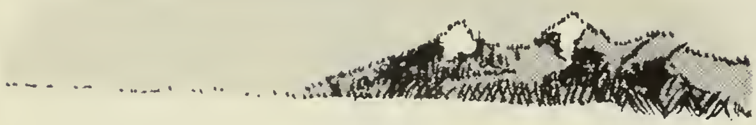
National Forest	No. Acres Leased	No. Acres Pending Application for Lease
Beaverhead	925,046	718,634
Bitterroot	0	345,381
Custer	1,447,516	184,627
Deer Lodge	368,711	287,946
Flathead	576,130	1,357,949
Gallatin	230,927	212,092
Helena	323,754	386,882
Kootenai	71,319	211,633
Lewis & Clark	308,129	569,658
Lolo	4,107	664,925

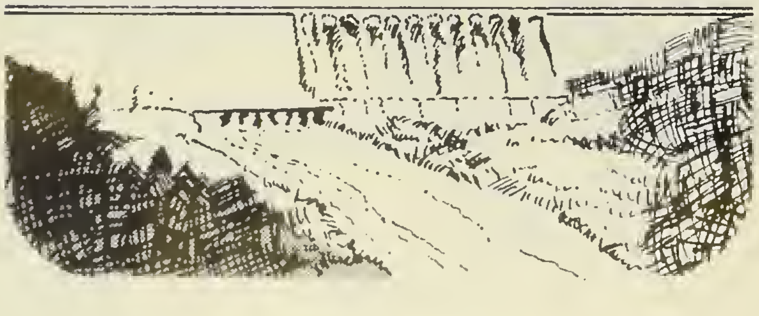
Source: Northern Region, U.S. Forest Service

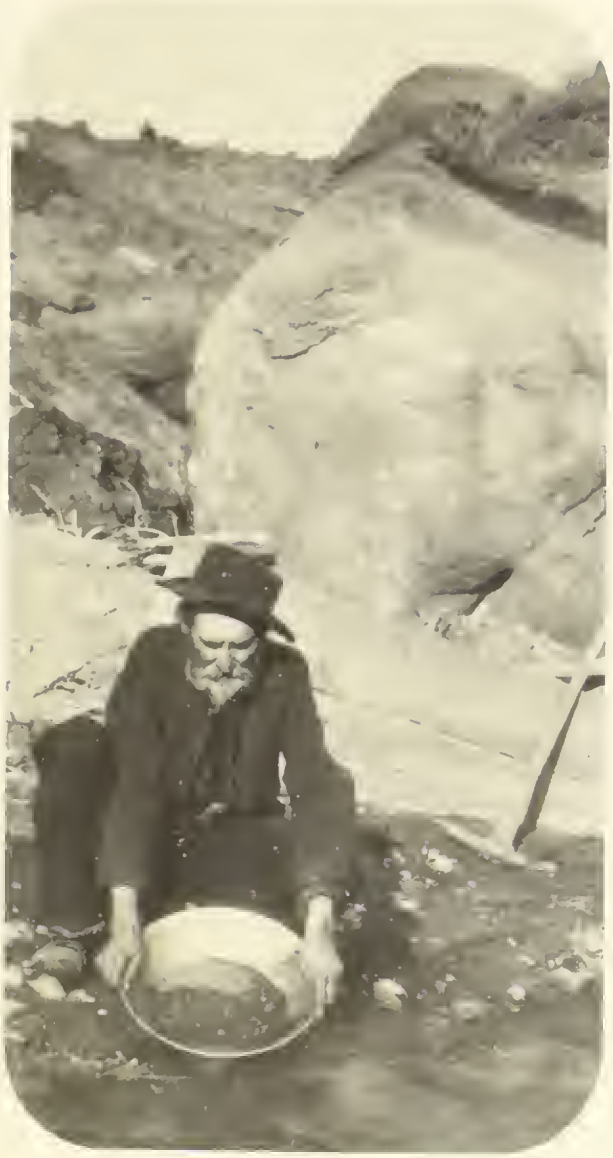
HYDROELECTRIC

Dozens of applications have been submitted to the Federal Energy Regulatory Commission (FERC) for permission to explore the development of small scale hydroelectric ("micro-hydro") projects on headwater streams in western Montana. The majority of applications to date have been for projects in Lake and Lincoln counties. A typical micro-hydro development consists of: 1) a 2-foot high diversion dam, 2) a 4,000-foot long, 20-inch diameter water penstock, 3) a 300 kw capacity powerhouse and 4) a short transmission line that would tie into the existing electrical power grid. Potential water quality problems accruing from the installation and operation of these facilities include temperature changes, gas supersaturation, excessive dewatering and sediment and turbidity from instream construction and runoff over disturbed soils. Activity so far in Montana has been largely speculative, with no projects in operation. The WQB is monitoring the development of small hydroelectric projects closely, and has prepared a letter to prospective developers warning of possible water quality problems and required state authorization. The WQB is also monitoring research on ways to mitigate potential water pollution from this renewable energy technology.

A number of existing dams in Montana are being considered for retrofitting hydroelectric powerhouses. There have also been proposals in recent years for new major hydroelectric dams, including Kootenai Falls on the Kootenai River and Carter Ferry on the Missouri. All such installations, if not properly designed, have the potential to cause water pollution, particularly with dissolved gases. The WQB continues to review plans for these facilities to insure they do not violate water quality standards.







Montana Travel Promotion Bureau

PLACER MINING

Currently, the worst mineral-related water quality problem, by virtue of sheer numbers, is placer mining. Placer mining causes sedimentation and destroys riparian habitat. Placer activities are numerous and portable, hence they are hard to police against water quality violations. Their impacts are generally restricted to the mountainous areas in western Montana. Twenty-six placer operators applied for MPDES permits in 1981, but the WQB believes many more operations were discharging without permits. Manpower limitations reduce the ability to locate many illegal operations. The short-term nature of these activities discourages operators from applying for a discharge permit, which they know will take the WQB a minimum of 60 days to process. This is a good reason to issue general permits (see Permits and Enforcement), which will cut the processing time and encourage more placer miners to come under the permit program.

In order to learn more about placer mining activity in Montana and to mitigate water quality impacts, the WQB has signed a contract with the DSL to publish a handbook that will tell miners how to properly build settling ponds, will send representatives from both agencies to Montana Mining Association chapter meetings to explain water quality laws and regulations and will conduct joint field inspections during 1982 of drainages known to have concentrations of placer mining.

TOXICS

Modern living has become dependent on the manufacture and widespread use of a variety of synthetic and potentially toxic chemicals. When confined to the area and purpose for which they were intended, these chemicals rarely pose a threat to water quality. But occasionally they escape—from fields, landfills or storage and shipping containers—and endanger the lives of people, plants and animals.

Another source of toxic elements is the earth itself. Some of the state's geologic formations produce concentrations of trace elements in groundwater supplies that exceed drinking water standards. (See Public Water Supply.) Geysers in Yellowstone National Park contribute natural trace element pollutants to the headwaters of the Yellowstone and Missouri rivers in Montana. But it is the oxidation and processing of sulfide mineral ores that create the most serious problems, among them acid mine drainage.

The threat to people from toxics in the aquatic environment can best be measured in two ways; by testing for toxic chemicals in the water people drink and in the fish people may eat. In recent years, the WQB has been involved in several monitoring programs that have accomplished these objectives.

Communities using surface water supplies in Montana are required to measure and report concentrations of six pesticides—endrin, methoxychlor, toxaphene, lindane, silvex and 2,4-D—once every three years. Measurements made through April 14, 1982, indicate all surface supplies are safe; none had concentrations of these chemicals that would be harmful to people.

During the endrin episode of 1981, the WQB analyzed samples from nine community water supplies, using both ground and surface water, in heavily sprayed areas (Table 14).

Table 14. Community water supplies sampled for endrin.

Community	Groundwater Source	Surface Water Source
Baker	X	
Big Sandy	X	
Broadus	X	
Ekalaka	X	
Fort Benton		X
Glasgow	X	
Glendive		X
Hardin		X
Miles City		X

None of these special samples had concentrations of the six pesticides that exceeded drinking water standards. A number of other public and private supplies had their water checked voluntarily and the results were also negative.

At about the same time, a large number of edible sport fish were collected by the DFWP from waters adjacent to areas heavily sprayed with endrin. The Chemistry Laboratory Bureau, DHES, analyzed 38 of these fish. Endrin levels in most of these fish were less than the detection limit and the rest were below the level considered harmful to people. An additional 20 fish collected by the DFWP from the Clark Fork and Yellowstone rivers were analyzed by the EPA, and proved to have low levels of endrin.

One hundred and fifty brown trout were collected from the upper Clark Fork River system in 1978, including 50 fish from the river's headwaters near the confluence of Warm Springs Creek and the heavily polluted Silver Bow Creek. Historically, the upper Clark Fork has suffered severely from heavy metals pollution from the Butte/Anaconda mining and minerals processing complex.

Although metals in the Clark Fork are no longer acutely toxic to aquatic life, thanks to improved wastewater treatment, there is still concern about accumulation of metals in edible portions of sport fish.

Fish tissues were analyzed for mercury, copper, lead, arsenic, cadmium and zinc. None of the metals were present at concentrations that constitute a hazard to human health or aquatic life.

Finally, in 1980, sport and rough fish were collected by the DFWP from the seven National Stream Quality Accounting Network (NASQAN) sites adopted by the WQB as the core of its fixed-station monitoring network (see Control Programs— Monitoring). Fish were sent to the EPA lab in Denver where they were analyzed for 16 metals and 20 pesticides. Not one pesticide or metal exceeded allowable concentrations in fish flesh. In fact, no pesticides were found in any of the samples; if they were present, they were not detectable.

To be sure, there are occasional and temporary "hot spots" in Montana where an accidental spill or a long-standing chronic problem has poisoned aquatic life. An example is Silver Bow Creek. But it is reassuring to note that, for the most part, Montana waters are still relatively free of toxic substances. However, this fact should not be taken for granted. A vigilant effort must be maintained to prevent degradation of water resources by the proliferation of toxic chemicals. For this reason, the WQB will continue to monitor toxics in drinking water and fish as time and resources allow.

control programs

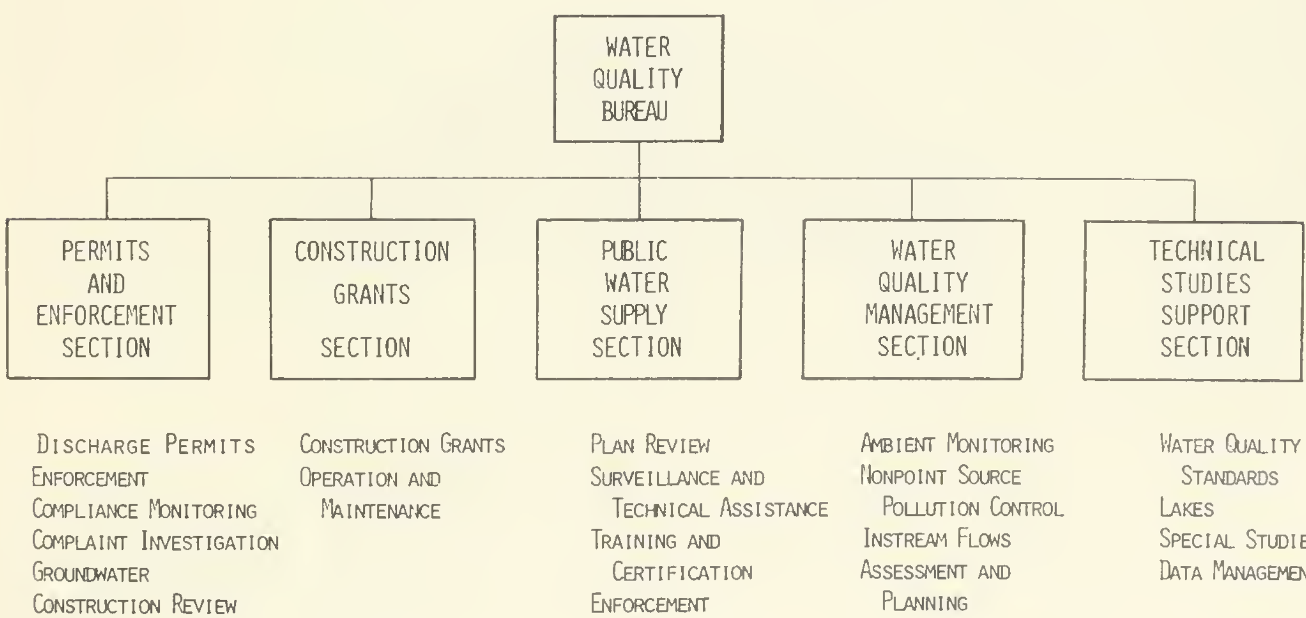
There are two basic components of Montana's water pollution control program: prevention and correction.

Efforts to prevent water pollution are, at best, taken for granted and, at worst, maligned and obstructed by those who see them as threats to development and economic prosperity. On the contrary, as is the case with any renewable resource, maintaining a quality resource base is essential to long-term productivity.

Clean water is required for agriculture and for recreation-based tourism, two of Montana's largest industries. Livestock, wildlife, fish and irrigated plants are not the only living things that need ample supplies of pollution-free water. Certain supplies must be maintained at the highest level of purity to protect the health of the state's citizens and visitors.

There is a large backlog of water quality problems in Montana, most of them dating back to an era of resource exploitation before laws were enacted to protect the environment and before the relationship between a clean environment and human health and prosperity was understood. Most of these problems are identified in the Appendix. Efforts to correct them are shared by many government agencies and citizen groups, but continue to be hampered by a severe shortage of planning and implementation funds.

This chapter describes the surface-water pollution control programs of the WQB. (Groundwater pollution control programs are described under the assessment of groundwater problems.) Brief reports are given on status, accomplishments, problems and objectives of each program. The WQB is not alone in these efforts; there are similar programs at all levels of government to accomplish many of the same water quality goals. But the WQB is the primary agency responsible for administering and enforcing state and federal water pollution control and water supply laws.



PRIMARY RESPONSIBILITIES OF THE WATER QUALITY BUREAU

MONITORING

The purpose of monitoring is to provide information for water pollution control. Water quality monitoring is the first line of defense against pollution. Monitoring is required for a number of purposes, among them setting stream classifications, establishing and enforcing water quality standards, detecting trends, determining wastewater treatment requirements, allocating waste loads, evaluating pollution impairment of beneficial uses, arranging problems in order of priority for cleanup action and assessing the water quality improvements realized from cleanup action.

This section deals with ambient, instream monitoring performed by the Water Quality Management Section of the WQB. Monitoring in response to complaints and to check compliance with limits set for permitted discharges ("compliance monitoring") is discussed under Permits and Enforcement. Monitoring of public water supplies is discussed under Public Water Supply. Self-monitoring of municipal and industrial effluents is not discussed here. All water quality monitoring performed by the WQB conforms to EPA quality assurance guidelines, and all data collected are incorporated into the bureau's data management system, as described at the end of this section.

The WQB's monitoring program has five principal components: 1) fixed-station monitoring, 2) biological monitoring, 3) intensive surveys, 4) quality assurance and 5) data management.

FIXED-STATION MONITORING

Monitoring is expensive. A routine water analysis for basic dissolved substances and nutrients could easily cost $250; additional analyses for metals, pesticides and biological components could push the per-sample price well over $1,000. Consider that Montana has about 4,000 streams, that many streams are too long to be monitored adequately with just one or two stations, and that sampling would have to be repeated at frequent intervals to characterize seasonal conditions. Add to this the travel costs and logistical problems of sampling over an area of 147,000 square miles, and you can easily see that complete water quality monitoring coverage for Montana would have a multi-million dollar price tag.

The principal fixed-station water quality monitoring agency in the state is the Water Resources Division, USGS, a division of the Department of the Interior. This agency does contract monitoring for a number of state and federal agencies or "cooperators." The USGS operates a network of about 75 stations statewide. The number of stations and the frequency of sampling at some stations are being reduced due to cuts in federal funding and agency monitoring budgets.

Eighteen of the stations sampled by the USGS are part of the NASQAN. Seven of these stations have been adopted by the WQB at the request of EPA to serve as the core of the fixed-station ambient water quality monitoring network (Table 15 and Figure 5). In addition to the array of physical, chemical and biological variables measured at NASQAN stations every two months, the WQB pays the USGS to collect data for chemical oxygen demand (COD) and total suspended sediment (TSS). Also, the WQB periodically contracts with the DFWP to collect game and rough fish at these same seven sites for analysis of toxic metals and pesticides at the EPA laboratory in Denver. The last fish collections and tissue analyses were performed in 1980. The results are presented elsewhere in this report (See "Toxics").

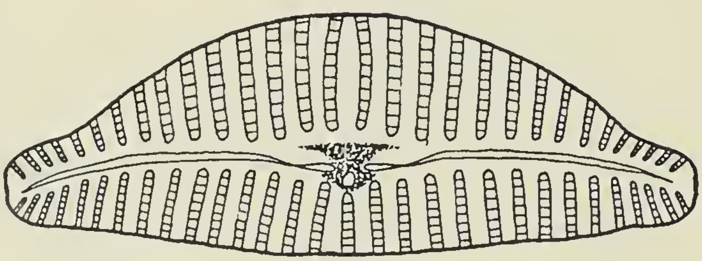


Table 15. Ambient water quality monitoring stations operated or supported by the Water Quality Bureau.

ıp No. ,Fig. 5)	Station Name	USGS Station No.	Operator
1	Clark Fork R. at Deer Lodge		WQB
2	Clark Fork R. below Missoula	12353000	USGS
3	Flathead R. at Flathead B.C.	12355000	USGS
4	Milk R. at Nashua	06174500	USGS
5	Missouri R. at Toston	06054500	USGS
6	Tongue R. at Miles City	06308500	USGS
7	Yellowstone R. near Livingston	06192500	USGS
8	Yellowstone R. at Billings	06214500	USGS

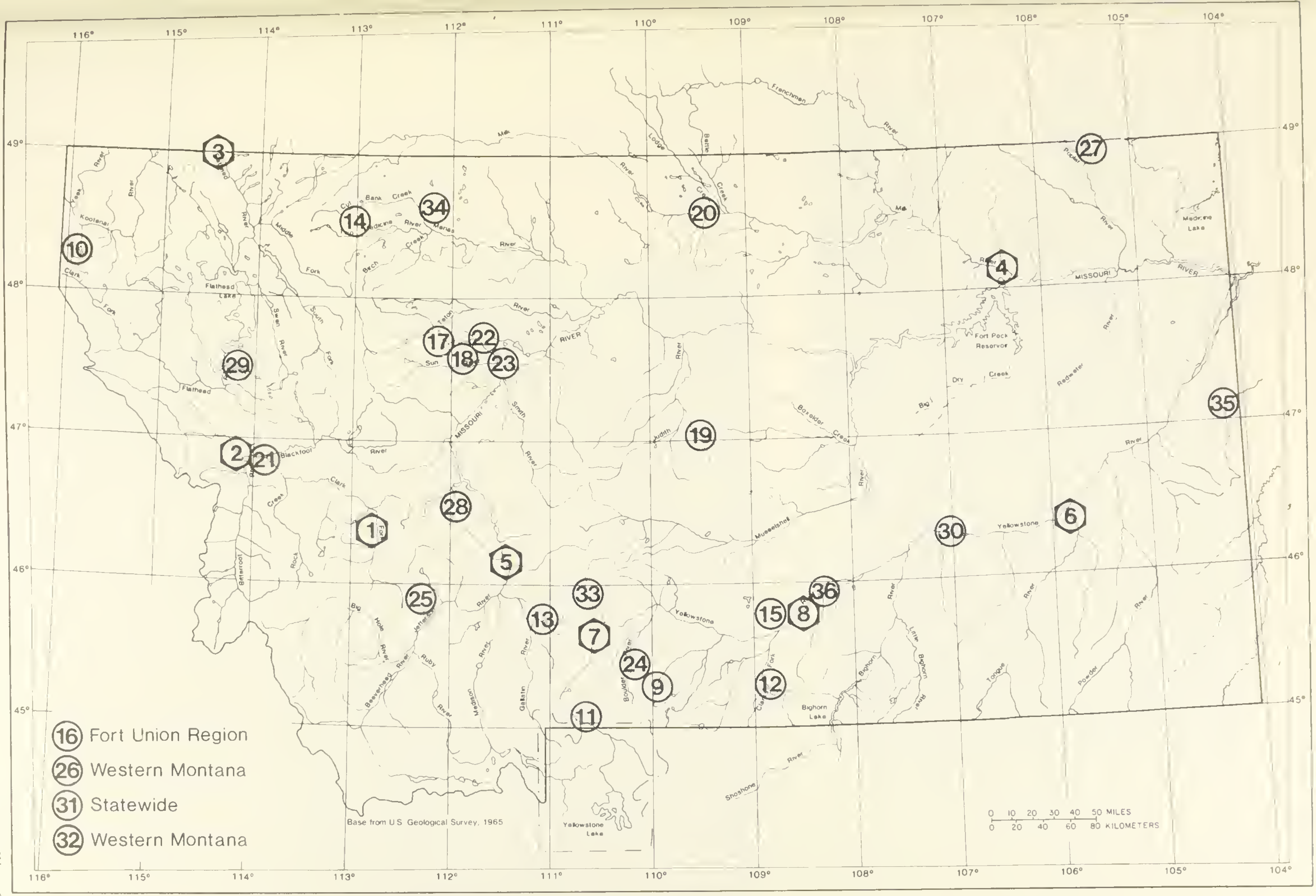


FIGURE 5. AMBIENT WATER QUALITY MONITORING STATIONS AND INTENSIVE SURVEYS.

On its own, the WQB maintains an ambient water quality monitoring station on the Clark Fork River at Deer Lodge (Figure 5). The WQB began monthly monitoring in 1978 for flow, common ions, algal nutrients (nitrogen and phosphorus), selected heavy metals and other parameters. The Upper Clark Fork River is Montana's water pollution horror story of yesteryear. It was long abused by industrial and municipal wastes from the Butte/Anaconda mining district.

Although the river has recently been on the mend, thanks to improved wastewater treatment, its quality still fails to meet criteria designed to prevent eutrophication and to protect fish and aquatic life. Multiple pollution sources in the Upper Clark Fork River drainage, some of them very difficult to control, continue to plague the river with dissolved salts, metals and nutrients. Because of the recent closure of the Anaconda Reduction Works and the Berkeley Pit in Butte, the WQB feels it is more important than ever to continue operating this station. Twenty years worth of hard-won water quality improvements in the Upper Clark Fork drainage could be lost in the twinkling of an eye if current pollution control efforts are abandoned along with the immense mining enterprise that once made Butte/Anaconda the cultural, financial and political capital of the northern Rockies.

Much of the monitoring data collected in Montana is not being used to its fullest potential. Trend analysis is a primary justification for fixed-station monitoring, yet trend analyses are rarely attempted because of complicating statistical and hydrological factors. The WQB feels that the USGS, the agency that collects and analyzes the great majority of fixed-station water quality monitoring samples in Montana, is in the best position to evaluate water quality trends.

Traditional fixed-station water quality monitoring is very expensive and, for this reason, the WQB doesn't do much. Its entire budget could easily be devoted to rigorous monitoring at just a few stations, with nothing left over for enforcement and other pollution control responsibilities that are the sole prerogative of the DHES. Instead, the WQB found that a combination of intensive surveys and a monitoring technique employing biological instead of chemical indicators of water quality is much more cost-effective.

BIOLOGICAL MONITORING

Biological monitoring has the multiple advantages of limiting the number of variables that need to be measured and the frequency of measurement, and at the same time giving a direct measure of impairment to aquatic life. It is based on the premise that biological organisms integrate the effects of all the pollutants to which they are exposed and express these effects in terms of survival and reproductive success. However, ambient biological monitoring is subject to the same statistical limitations as traditional fixed-station monitoring, requires special knowledge in organism identification and is labor intensive.

Montana established a statewide network of biological monitoring stations in 1977. The network includes 85 stations on 59 streams, with at least one station in each of the state's major drainage basins. The stations are grouped geographically to simplify sampling logistics and reporting (Table 16 and Figure 6).

Seasonal basic or baseline biological conditions were established at each of these stations from 1977 through 1979. Bureau personnel measured abundance and diversity of invertebrates and algae, algae nutrients and growth, pH, alkalinity, conductivity,

Department of Health and Environmental Sciences

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Table 16. Montana biological monitoring stations.

SOUTHWEST LOOP

Map No. (Fig. 6)	Stream/Location
1	Beaverhead River at Twin Bridges
2	Big Hole River near Twin Bridges
3	Boulder River below Boulder
4	Clark Fork River at Deer Lodge
5	East Gallatin River near Belgrade
6	Grasshopper Creek near mouth near Dillon
7	Jefferson River near Three Forks
8	Madison River near Three Forks
9	Muddy Creek at mouth near Dell
10	Prickly Pear Creek at East Helena
11	Prickly Pear Creek near mouth
12	Red Rock River above Lima Reservoir
13	Ruby River near Twin Bridges
14	Sheep Creek above Muddy Creek
15	Silver Bow Creek below Warm Springs Ponds
16	West Fork Madison River near mouth
17	West Gallatin River at Central Park (I90)

NORTHCENTRAL LOOP

18	Big Sandy Creek near mouth
19	Dearborn River near mouth
20	Lodge Creek near Chinook
21	Marias River near Shelby
22	Marias River at Loma
23	Milk River At Havre
24	Milk River above Chinook
25	Missouri River at Cascade
26	Missouri River at Fort Benton
27	Muddy Creek near mouth at Vaughn
28	Pondera Creek near mouth near Chester
29	Smith River near Ulm
30	Sun River near Fort Shaw
31	Sun River below Vaughn
32	Teton River near Dutton
33	Teton River near Fort Benton

NORTHWEST LOOP

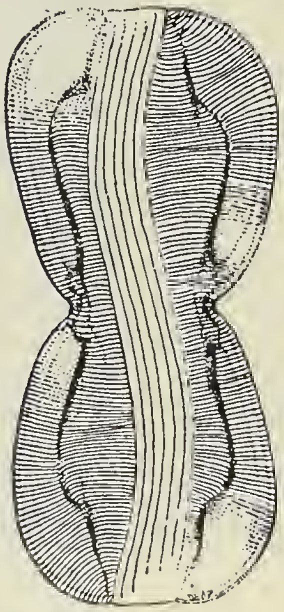
34	Bitterroot River near mouth
35	Clark Fork River below Bonner Dam
36	Clark Fork River at Huson RR Bridge
37	Clearwater River near mouth
38	Fisher River at mouth
39	Flathead River near Kalispell
40	Flathead River near mouth
41	Lake Creek near mouth near Troy
42	Little Blackfoot River at Avon
43	Middle Fork Flathead River near mouth
44	North Fork Flathead River near mouth
45	Stillwater River near mouth at Kalispell
46	Swan River near mouth
47	Swiftcurrent Creek near Babb
48	Whitefish River near mouth near Kalispell
49	Yaak River near mouth

NORTHEAST LOOP

50	Beaver Creek near Hinsdale at Beaverton
51	Box Elder Creek near Winnett
52	Big Muddy Creek near mouth near Culbertson
53	Big Spring Creek below Lewistown
54	Judith River near Utica
55	Judith River near Danvers
56	Judith River near mouth
57	Milk River at Nashua
58	Missouri River below Judith River
59	Missouri River at Fred Robinson Bridge
60	Missouri River at Culbertson
61	Musselshell River at Harlowton
62	Musselshell River above Roundup at Bundy
63	Musselshell River below Roundup at Delphia
64	Musselshell River at Mosby
65	Poplar River at mouth at Poplar
66	Redwater River at Circle
67	Redwater River near mouth
68	Wolf Creek at Stanford
69	Wolf Creek at Denton

SOUTHEAST LOOP

70	Armell's Creek (East Fork) near Colstrip
71	Beaver Creek at Wibaux
72	Bighorn River at Bighorn
73	Clark's Fork River near Laurel at Edgar
74	Little Missouri River at Capitol
75	Powder River at Broadus
76	Powder River near Miles City at Locate
77	Rosebud Creek near Colstrip
78	Shields River near mouth
79	Tongue River at Brandenberg
80	Tongue River at Miles City
81	Yellowstone River near Livingston
82	Yellowstone River at Billings (USGS Station)
83	Yellowstone River near Huntley
84	Yellowstone River at Forsyth
85	Yellowstone River near Sidney



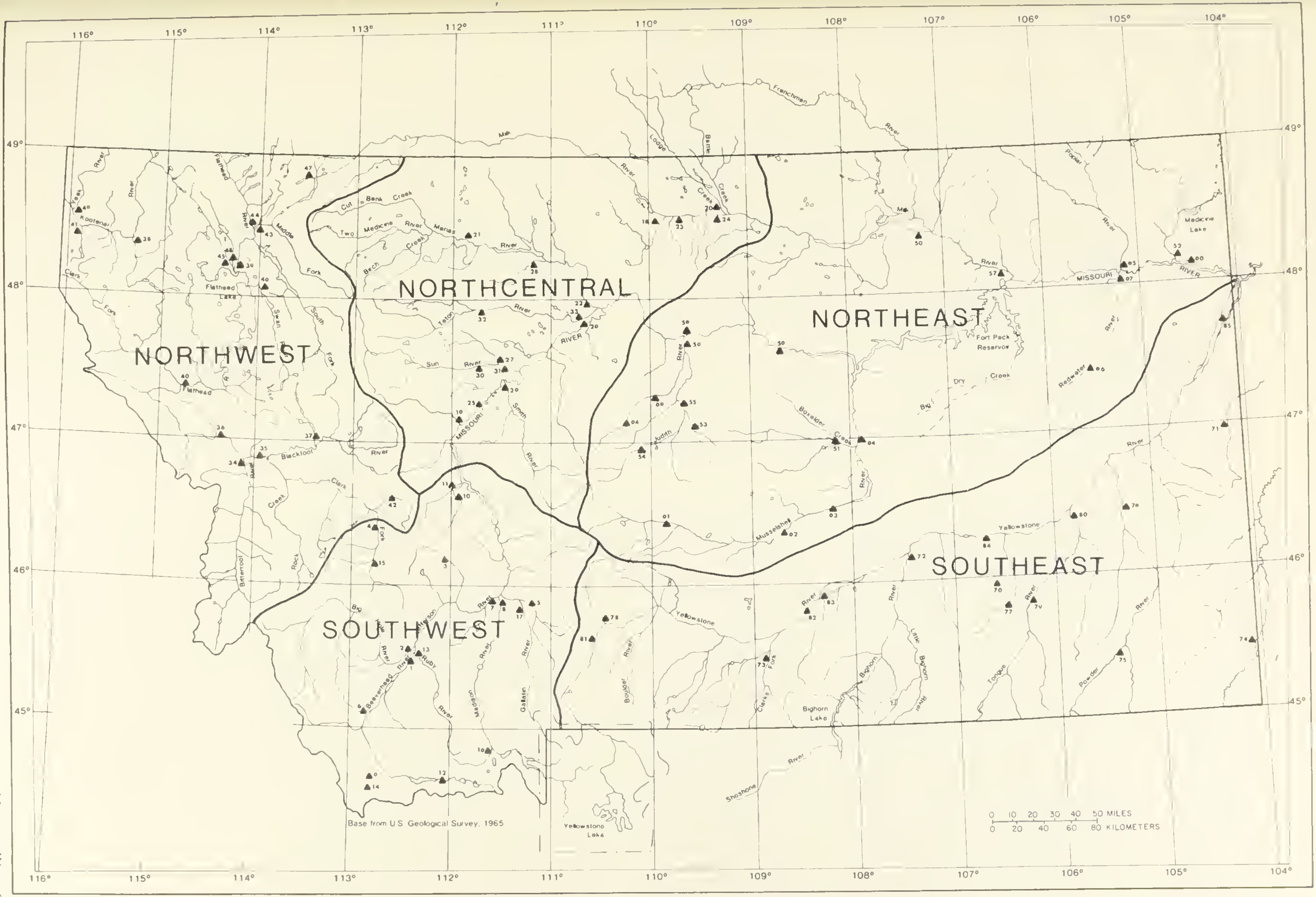


FIGURE 6. BIOLOGICAL MONITORING STATIONS AND LOOPS.

hardness and other water quality variables of biological significance. A return trip was made to each station during the summer of 1980 to sample algae and invertebrates once again. Analyses of the 1980 samples have not been completed.

Biological monitoring has already proven its worth in three ways: 1) It has shown that certain streams in western Montana are much more sensitive to acid deposition, acid-mine drainage and heavy metals pollution than streams in eastern Montana; 2) it has demonstrated that eastern Montana streams have aquatic communities that are every bit as diverse as those in western Montana, and 3) it has provided a biological norm for a variety of Montana streams against which to compare biological conditions in suspected problem segments.

A synopsis of findings from the WQB's biological monitoring program will be published in the near future. Before the WQB resumes monitoring, it needs to determine the statistical reliability of the sampling techniques and establish the natural variability in biological conditions at each site in order to distinguish trends. Then, return sampling visits will be scheduled as time and resources allow.

INTENSIVE SURVEYS

Much of the WQB's water quality monitoring is performed to answer questions about the effects of specific municipal, industrial, mining, forestry and agricultural activities. This purpose is served by the intensive survey, which is a mobile and customized form of fixed-station monitoring. Intensive surveys are tailored to each situation and range from a one-day, reconnaissance-level sampling and inspection trip to a much more intensive, multi-year study. Recent and scheduled intensive surveys by the WQB are listed in Table 17 and mapped in Figure 5. Also, WQB personnel are assisting EPA biologists on Silver Bow Creek and Prickly Pear Creek with pilot studies designed to establish guidelines for setting site-specific water quality criteria.

A great deal of the monitoring conducted by the WQB has been supported by Section 208 Water Quality Management Planning funds from EPA: about half of the fixed-station monitoring, all of the biological monitoring and three-quarters of the intensive surveys. Section 208 is that part of the Federal Water Pollution Control Act that calls for integrated management of point and nonpoint-source pollution on an areawide and state basis. Section 208 is still intact, but the budget for this purpose was eliminated by the current federal administration. Funds on hand will support monitoring efforts through June 30, 1983. It appears there is only a slight prospect of congressional funding for state water quality management programs, which means Montana and other states must turn to their legislatures for help in this critical area.

In the face of funding reductions, the WQB's water quality management program will focus on priority problems, seeking maximum environmental effect per dollar. The problem severity analysis performed elsewhere in this report will serve as a guide. Monitoring emphasis will be placed on establishing pollution cleanup priorities and on documenting water quality improvements gained by water pollution control efforts. To the extent that available funds will allow, the Water Quality Management Section will continue to provide necessary information to other WQB programs and maintain the quality assurance and data management efforts described below.

Table 17. Recent and proposed intensive surveys by the Water Quality Bureau (1981-1983).

Map No. (Fig. 5)	Intensive Survey	Completion Date
9	Anaconda/Stillwater River reconnaissance	1983
10	ASARCO/Troy Project reconnaissance	1982
11	Bear Creek (Yellowstone R.) sanitary survey	1981
12	Bluewater Creek irrigation study	1983
13	Bozeman ammonia bioassay	1981
14	Browning ammonia survey	1983
15	Canyon Creek irrigation study	1982
16	Fort Union coal region biological inventory	1982
17	Freezeout Lake management study	1983
18	Greenfields Irrigation District groundwater nitrate study	1981
19	Lewistown ammonia survey	1982
20	Milk River chlorine study	1982
21	Missoula ammonia bioassay	1981
22	Muddy Creek nutrient study	1982
23	Muddy Creek/Sun River biological impact study	1982
24	PGM Resources/Boulder River reconnaissance	1983
25	Pipestone Creek sediment study	1982
26	Placer mining inspections	1982
27	Poplar River macrophyte inventory	1982
28	Prickly Pear Creek streambank inventory	1981
29	Ronan ammonia survey	1982
30	Rosebud County Conservation District irrigation return flow study	1983
31	Selected data-poor potential problem segments	1982-1983
32	Selected forestry-related inspections	1982-1983
33	Shields River streambank inventory	1982
34	Spring Coulee (Marias R.) salinity survey	1982
35	Wibaux ammonia survey	1982
36	Yellowstone River ammonia study	1982

QUALITY ASSURANCE

Accurate and reliable data are essential for water pollution control and these are the objectives of quality assurance.

The DHES policy, initiated by the Montana EPA Agreement (MEA), requires participation in a centrally managed Quality Assurance (QA) program by the Chemistry and Microbiology Laboratory bureaus, the WQB, and those monitoring and measurement efforts supported or mandated through contracts, grants, regulations or other formalized agreements. The WQB is responsible for developing, coordinating and directing the state QA program. The WQB has delegated this responsibility to the Quality Assurance Group made up of representatives from the WQB and the Chemistry and Microbiology Laboratory bureaus.

The purpose of the QA program is to insure that all environmental water quality data generated, processed or used within the DHES will be scientifically valid, defensible and of known precision and accuracy. All reported data will include documented precision and accuracy. Data must be complete, representative and comparable. In addition, data must meet QA requirements of national programs.

Effective management of a QA Program requires periodic assessment upon which any needed corrective action may be based. The state QA program is periodically evaluated by EPA personnel. In addition, the Quality Assurance Group annually performs self-audit evaluations of water chemistry and microbiology lab procedures, field sampling and data handling. Following the FY 1980 evaluation, state personnel were commended for their extensive QA activities and successful development of the program. It was recommended that future QA efforts focus on program maintenance rather than additional program development. Thus, emphasis in FY 1981 was placed on program maintenance.

In addition to QA program maintenance, state personnel are preparing a Quality Assurance Program Plan and Quality Assurance project plans for each water monitoring activity, outlined in the FY 1981 MEA. The program plan has been completed. Project plans will be completed as time is available.

Identified during the FY 1980 on-site evaluation were problems in analytical precision and accuracy for some parameters and occasionally excessive turn around times for chemical analyses. The analytical problems were quickly resolved. The turn around time problem was more difficult to correct. Weekly meetings were initiated between the WQB and the Chemistry Laboratory Bureau in an effort to determine laboratory work capabilities and to improve the sample workload schedule. The result has been a great reduction in turn around time, now averaging less than 30 days from the time the sample is submitted to receipt of computer-processed results. In FY 1981, the DHES budget cuts reduced the chemistry laboratory analytical staff by 50 percent. However, dwindling funds for monitoring programs have resulted in a steadily declining sample load.

Plans for 1982 and 1983 call for maintaining a QA program. QA project plans will be completed for specific monitoring activities. Work began on a QA plan for the WQB's Billings branch office laboratory. However, it now appears, the lab will either be closed or the number of parameters restricted to simple tests because of staff reductions. As such, QA program development will not be pursued for that lab. Instead, monitoring performed there will fall under guidelines for field monitoring.

DATA MANAGEMENT

The DHES maintains a computer file on nearly all water samples analyzed by the department's Laboratory Division. The file contains data on approximately 19,200 water samples that have been collected since 1973. An estimated 11,500 of these are from natural surface waters in Montana. The other 7,700 samples are from wells, man-made discharges, and miscellaneous sources. The file grew by a total of about 4,000 samples from January 1, 1980 to December 31, 1981.

The primary objective of the DHES data management program over the past two years has been to make these computerized water quality data more usable as baseline information and as a data base for water quality studies. These goals have been partially realized. The time required for getting information into the computer file has been reduced, and the procedures for transferring data to EPA's STORET system have been improved. Additionally, by correcting and standardizing some of the sample location categories, the data have been made easier to retrieve. This has reduced the number of individual site locations and the number of stations entered into STORET. The accuracy of the data has been improved by correcting storage and program errors.

In carrying out these objectives, approximately 38,900 changes and corrections were made to the water quality computer file. In addition, about 14,400 biological measurements were added to complement the chemical and physical data.

However, there are some data management needs that have not been met due to a lack of time and money. One is for standardizing sampling sites on frequently sampled stream segments, and for samplers to be reminded to sample at these predetermined locations. Another need is to check water analyses for possible erroneous values. The major ions in many samples are already being checked by an ionic balance test and by a comparison with the sample's specific conductance. However, samples that have not been analyzed for all the major ions cannot be checked by these tests. Heavy metals and other ions of low concentration are not subjected to automatic, computerized tests. One important test that could be made is to compare the lab results with previous values for the same sampling site. This test should be done immediately after the lab analyses are completed so samples with unusual results can be re-analyzed. Project managers should continue to examine lab results at their earliest opportunity and to correct erroneous data.

A major problem is the difficulty of retrieving existing water quality information from various state and federal agencies. Computerized data are in many different formats, which may require extensive computer programming to be useful to other agencies. Non-computerized information, buried in reports and files, is often unknown to other agencies. These problems are especially pertinent to statewide assessments, like this one, that require the evaluation of large amounts of data covering a wide geographic area. Water resource decisions sometimes are based on a limited amount of information even though additional information does exist, but is not readily available. Such decisions are more likely to be in error and lead to unnecessary costs.

The obvious solution is to centralize all Montana water quality information and give the agencies using the data the equipment to store and retrieve it. EPA's STORET system is a big step in this direction. However, the system has failed to obtain a complete set of available water quality data and needs to be given special emphasis by all participating government agencies. Furthermore, the STORET system's storage and retrieval functions need to be enhanced; this would also attract new users. An alternative to beefing up the STORET system would be for Montana to develop its own centralized system. This would duplicate some of the STORET functions, but would allow for a system that fulfills Montana needs without catering to the desires of the other 49 states.

PUBLIC WATER SUPPLY

The WQB has been given full responsibility by the EPA for administration of the Safe Drinking Water Act. The program is concerned with 1,896 public water supplies, of which 594 are community systems (cities, towns, subdivisions and trailer courts) and the remainder non-community systems (mostly bars, campgrounds, cafes, and motels). One of the most important aspects of the job is to monitor the water served by these supplies to insure that bacterial, chemical and radiological contents remain within safe limits. Additionally, each public water supply system is inspected annually, and an effort is made to work closely with local operators. Montana's regulations require that the WQB review and approve all construction and modifications to public water and sewer systems.

The public water supply program has changed dramatically in the past few years. While the staff has doubled, the number of regulated public water supplies has multiplied six times the original number. The program's growth necessitated a complete revamping of the WQB's record keeping system, thus streamlining efforts to obtain compliance with the regulations. Also, the addition of a word processor has increased efficiency.

The public water supply staff talks daily to water system operators throughout the state to assist in solving an array of problems. Some of the more common problems include bacterial contamination, flooded wells, equipment failure, funding, operator training needs and chemical, radiological and organic contaminants.

Presently the program's most serious problem is the proposed decrease in federal funding. Any decrease in funds will necessitate a comparable or greater decrease in staff, making it impossible to administer the laws and regulations. In light of the proposed funding cuts, the primary objectives are to increase the efficiency of the program and determine the areas of highest priority.

GROUNDWATER PROBLEMS

The water for more than 95 percent of Montana's public water supplies comes from groundwater, but these sources serve only about 30 percent of the people who use public systems. There are a surprisingly small number of health-related problems. Eighteen community systems exceed the maximum contaminant level (MCL) for fluoride; five, the nitrate MCL; two, the arsenic MCL, and two exceed the MCL for selenium. Of lesser significance are those waters that are safe to drink, but taste, look and smell bad. Many of the groundwater sources east of the Rockies have one or more problems associated with dissolved solids, iron, manganese, hydrogen sulfide gas, sodium and sulfate. In some areas prone to saline seep, the groundwater has become so poor that farmers have been forced to haul water or, with the aid of Farmer's Home Administration loans and grants, build extensive rural water systems.

Generally, Montana's groundwater sources are not vulnerable to bacterial contamination. Very few require chlorination. Two things that have caused concern recently are falling water tables—as in the Glasgow area—and the cross-contamination or mixing of aquifers caused by oil exploration (See Groundwater and Energy Development.).

SURFACE WATER PROBLEMS

Approximately five percent of Montana's public water supplies use surface water. However, these systems provide water to about 70 percent of the people who get their water from public systems. The major concern is that many supplies have no treatment other than chlorination. This leads to violations of the MCL for turbidity and occasionally to serious health problems. For example, Dr. James J. Kane of Red Lodge estimated that more than 1,000 area residents were treated for giardiasis in 1981. Giardia is a pathogenic intestinal parasite that causes severe cases of diarrhea. About 50 of these cases required hospitalization. Cases of waterborne giardiasis have also been reported in White Sulphur Springs, Bozeman and Helena.

Taste and odor problems associated with algae blooms have also been a problem for many surface water systems. One of the worst outbreaks occurred in Helena in the fall of 1981. One Montana community—Saco—had cause for concern in the summer of 1980 when a toxic blue-green algae bloom occurred in Nelson Reservoir, the town's principal water supply.

A few communities with surface water systems are seeking to alleviate such problems by building treatment plants or switching to groundwater. Many of them, however, are not financially able to make the needed improvements.

PERMITS AND ENFORCEMENT

The Permits and Enforcement Program administers the following water pollution control rules: 1) The Montana Pollutant Discharge Elimination System (MPDES), 2) the Montana Surface Water Quality Standards, (MSWQS), 3) the Montana In Situ Mining of Uranium Control System (MIMUCS) and 4) the proposed Montana Groundwater Pollution Control System (MGWPCS).

Under MPDES, all point source waste discharges to surface waters must be permitted by WQB. Each permit contains limitations and conditions which insure that state water quality standards will not be violated by the discharge. The WQB has 180 days to process an application, which includes time for public participation and a hearing, if requested. The WQB may require self-monitoring by permittees, conduct field inspections and monitoring and take enforcement actions to insure compliance with permit conditions. Permits are reevaluated and renewed on a regular basis. All information on permits must be transmitted to the EPA.

Under MSWQS, complaints of water pollution are investigated and resolved; plans for short-term instream construction are reviewed and modified to reduce the effects on water quality, and plans for leach pads, tailings ponds and ponds used in the processing of ore are reviewed to insure that toxic chemicals will not escape and degrade water quality.

MIMUCS requires the WQB to review plans and process permits for in situ or "solution-mining" of uranium. This is a very complex technology and will require special expertise to review such applications when activity gets underway.

MGWPCS will require the WQB to review and permit certain activities which could pollute groundwater. Activities now covered by other permit programs (such as mines under DSL operating per-

Department of Fish, Wildlife and Parks

mits) will be reviewed cooperatively with the WQB to insure compliance with groundwater quality standards.

STATUS

The WQB is presently administering more than 400 MPDES permits. MPDES activity has jumped sharply in the past two years, reflecting the amount of resource development in Montana. From the beginning of the MPDES program in 1974 through 1979, new MPDES applications averaged about 27 per year. In 1980, 88 new applications were received, and in 1981 there were 95 new applications. About 75 percent of the new applications in 1980 and 1981 were related to resource (including energy) development. Meanwhile, old permits are coming up for renewal every year. A total of 131 MPDES permits were issued in 1981.

With this increased workload and no additional people, the Permits Section staff is being spread thin. Inspection schedules can no longer be met for small discharges. More time must be spent on groundwater problems. Hundreds of small hydropower projects are planned for Montana, and each will involve a small diversion dam, some instream disturbance and a discharge.

Complaints and enforcement exert a steady demand on the WQB resources. About 100 complaints were received and investigated in 1981. Enforcement actions ranged from phone calls to lawsuits with resulting court actions and fines. The number of oil and hazardous material spills reported to the WQB in 1981 was up 73 percent from 1973.

PROBLEMS

The biggest problem in the permits and enforcement program is the rapidly increasing workload.

The need is either to increase staff or cut paperwork. To cut paperwork, the WQB has proposed to modify existing MPDES regulations to allow for issuance of general permits covering a wide variety of minor pollution sources. Some of the categories are:

1) cofferdam discharges,

2) groundwater pump test discharges,

3) fish farms,

4) placer mining operations,

5) small suction dredges,

6) oil well produced-water discharges for beneficial use,

7) animal feedlots,

8) common facultative sewage lagoons and

9) sand and gravel mining and processing operations

General permit regulations would greatly reduce paperwork and keep the workload at a manageable level. It would also enhance enforcement capabilities since more staff time would be available to perform vital compliance inspections. It's been estimated nearly 70 percent of the new applications in 1981 could have been handled under general permits.

ACCOMPLISHMENTS (1980-1981)

During 1980-81 a draft groundwater protection regulation and a draft general permit regulation were prepared. During 1981, 131 MPDES permits were issued and 101 complaints were investigated. Eighty-eight oil and hazardous material spills were reported, about 1,500 self-monitoring reports were received and reviewed, and 49 compliance inspections were made. Four Helena Valley sewage lagoons were studied to document the amount of seepage. A Hazardous Materials Response Plan was completed in cooperation with the State Disaster and Emergency Services Division. A significant pollution problem at the Sparrow Resources Mine and Mill near Helena was brought under control and suits against Goldsil Mining near Helena and the CENEX Refinery at Laurel were settled. About 350,000 gallons of diesel fuel were recovered from a major groundwater contamination area in Miles City.

OBJECTIVES

Objectives for the coming year include keeping up with MPDES applications; making timely field inspections of placer mining, suction dredging and other mining and milling operations in western Montana; putting groundwater and general permit regulations into effect, and keeping current on complaints, response to oil and hazardous material spills, and compliance monitoring of major permittees.

CONSTRUCTION GRANTS

STATUS

The federal grant program to fund the construction of wastewater treatment facilities began in 1956. In 1972 the Federal Construction Grants Program was passed into law and has become one of the largest public works programs in existence. From 1972 until now, the program has been plagued with excessive paperwork, late appropriations, recisions, deferrals and, at times, total chaos. These problems and subsequent public discontent have subjected the program to the present administration's budget-cutting hatchet.

The culmination of all these events was the December 29, 1981, passage of the Municipal Wastewater Treatment Construction Grant Amendments of 1981, which will greatly change the grants program. However, Congress with these amendments, did authorize continued funding of the program for four years (FY 1982-86). Some of the major changes were: 1) reduced federal share after October 1, 1984 from 75 percent to 55 percent, 2) reduced number of eligibility categories and the amount of reserve treatment capacity built into plants, 3) elimination of funding for planning and design grants with the exception of small, needy communities and 4) a requirement that the design engineer remain obligated to the grantee for one year to ensure that the facility will operate as designed.

Once again, the program is in a state of flux until all the wrinkles are ironed out under the new law. If the appropriations for FY 1982 through FY 1986 equal the authorized level of $2.4 billion per year ($12 million per year for Montana), Montana's major wastewater treatment needs will be met by the end of FY 1986. However, continued operation of the new facilities and upgrading will be necessary as the existing plants deteriorate and reach peak capacity.

ACCOMPLISHMENTS

During the last biennium (FY 1980-81) Montana saw tremendous activity in both the administration of the construction grants program and initiation and completion of projects. On April 1, 1981, the DHES received total delegation of responsibility for the program from the EPA. This delegation brought both relief and apprehension. Although the DHES could make decisions with the best firsthand knowledge of the problems, thus moving projects faster and smoother through the mire of bureaucracy, it was held responsible for each decision, sometimes without the backing of the EPA. This was accepted by the DHES because the benefits of expediting the projects outweighed the time and financial burden that duplicative reviews placed on those applying for grants.

During the last two years the DHES passed on to local governments more than $38 million for the construction of wastewater treatment facilities. Local governments spent about $14 million, thus collectively, $52 million was spent to improve the public health and water quality of the state. Additionally, local economies benefited through jobs and support services. More than 30 major projects were funded, ranging from upgrading of existing plants to construction of total wastewater facilities, including collection and treatment systems.

One Montana community that received funding was Plains. With a population of 1,200, Plains was the largest unsewered community in Montana. The residents of the community were plagued with failing septic tanks, inadequate waste treatment, odors and nuisance conditions from sewage running on top of the ground. Even though the community has a water system, a real public health hazard existed. A thorough analysis of various collection and treatment alternatives resulted in the selection of a conventional gravity collection sewer followed by aerated lagoons which discharge to groundwater infiltration beds. The project has been designed and bid. Construction should be completed in 1983. The cost of the project, with the grant, amounts to a monthly user charge of about 12 dollars per household. Without federal assistance the project would have been completely out of the community's financial capabilities.

Also funded was a treatment system at Three Forks which will eliminate the largest untreated municipal wastewater discharge in Montana. Projects were funded to eliminate wastewater sludge problems in Helena, Kalispell and Missoula. Even though these facilities produce clear effluents that discharge to receiving streams, the solids removed from the wastewater are not adequately treated and disposed. Sludge treatment is an important process at every mechanical treatment facility. If improperly handled, it can produce odors and water quality problems that affect the whole community.

The City of Bozeman has been involved in the Construction Grants Program for the last 10 years. Construction began in 1981 for the city's advanced secondary treatment facility. Construction should be complete by the end of 1983. During the summer of 1981, the DHES took a second look at the application of rigorous water quality standards placed on the discharge from the Bozeman Wastewater Treatment Plant to the East Gallatin River, a high quality trout stream. This analysis resulted in a reduction of treatment needs without any sacrifice of water quality, and lowered the construction costs by about $2 million. It saved the community $500,000 and allowed the DHES to fund other projects with the $1.5 million earmarked for the Bozeman project.

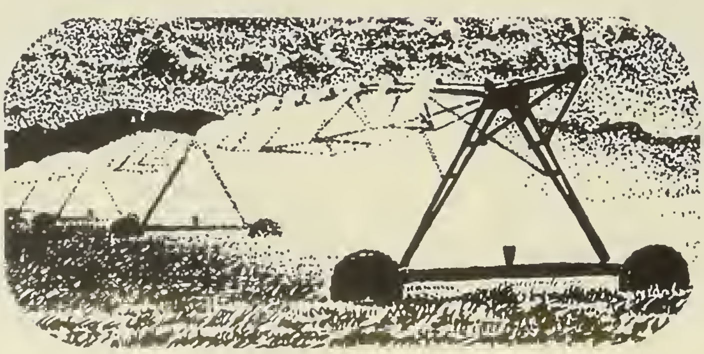
PROBLEMS

The major problem with the Construction Grants Program has been the tremendous amount of paperwork that was needed to get the funds spent and the projects completed. The federal administration's deregulation efforts and passage of the Municipal Construction Grants Amendments were accomplished in 1981. This resulted in a reduction of paperwork. But, a new element has arisen to become the number one problem to the grants program—budget cuts. During 1981, the federal administration rescinded more than $8 million in funds available to the Montana Construction Grants Program. It's unknown whether Congress will fund the program in FY 1982, even though it authorized the program from FY 1982 through FY 1986. Should there be no appropriation, the goal of getting municipal dischargers into compliance may never be met. Even if a 1983 appropriation is received, projects will have been delayed for at least a year, increasing costs and adding more stress to local economies.

OBJECTIVES

The primary objective of the Construction Grants Program is to provide financial assistance to communities that have not completed their wastewater treatment facilities. More than $50 million worth of work needs to be done on wastewater treatment in Montana to bring existing facilities into compliance and to eliminate documented public health hazards. Without a federal appropriation, the more streamlined program will be of little value. Should an appropriation be received, the DHES will pass the funds on to local governments.

One additional objective is to insure adequate operation of the completed projects. Through the use of training sessions, learning aids and on-the-site assistance, the DHES shall assist the communities in operating their facilities efficiently, helping them obtain federal funds for construction and aiding them in meeting permit limitations.



TECHNICAL STUDIES SUPPORT

One of the goals of the WQB is to keep Montana water clear enough for all applicable beneficial uses. The Technical Studies Support Section helps meet this objective by insuring that water quality standards are set so water quality is neither over- nor under-protected and by making certain that new developments do not violate water quality standards.

During the past two years the Surface Water Quality Standards have been revised to change the coliform standards so that dechlorination will not be required at most municipal discharges. This change can be made without affecting the beneficial uses of the receiving waters. The review also covered the ammonia and oil and grease limits imposed in discharge permits. As a result, the oil and grease limits remained unchanged and the ammonia discharge limits for the cities of Bozeman and Missoula were changed. New ammonia discharge limits were derived after performing bioassays, stream surveys and a technical review of the EPA criteria. These discharge limits are more liberal than the EPA criteria and will not affect beneficial uses of the water. This work will be used as a basis for reviewing other discharges in the state.

In addition to the revision of the Surface Water Quality Standards, new rules to implement the state's non-degradation law have been prepared and will soon be adopted. Developments reviewed for their impact on water quality include lake shore subdivisions, new and modified hydroelectric power plants, new and modified mining developments and new municipal discharges.

One of the proposed hydroelectric power plants—Kootenai Falls—would have caused violations to water quality standards. A revised design instigated by the review not only will prevent violations of the water quality standards, but will also decrease the cost of the project.

In the future the review of discharge limits and water quality standards will continue. However, the major impact of this section will occur through its review of new developments and the changes to developments resulting from the WQB reviews.

WATER QUALITY MANAGEMENT PLANNING

Section 208 of the Federal Water Pollution Control Act provides for integrated management of point and nonpoint-source pollution on an areawide and statewide basis. The objective of the 208 program in Montana and other rural states has been to control nonpoint, primarily agricultural, pollution by applying appropriate conservation practices on the land. Nonpoint pollution—in the form of sediment, salts and streamflow depletion—is far more prevalent in Montana than pollution from municipal and industrial discharges.

Until recently, funds had been allocated by Congress and EPA under Section 208 for planning to control nonpoint pollution sources. In Montana, these funds have been used mostly to help conservation districts and other local governments identify and design a means for correcting their most serious problems. The planning program never was adequately funded and money for implementation—through existing loan, grant and cost-share programs—is woefully inadequate. Now even planning funds have been eliminated from the recent federal budget and local governments will soon be without an option for local pollution control.

Originally, four areas in Montana with special water quality problems were designated by former Governor Thomas Judge to receive 208 planning funds, with the WQB responsible for planning in the remainder of the state. Now, because of a lack of local interest and support, only two areawide planning organizations remain: Flathead (Kalispell) and Blue Ribbons (Bozeman). (See Figure 7.) Even these are scheduled for termination in 1982 and 1983, respectively.

The days of the 208 program are numbered even though the mandate in Section 208 remains intact. Water quality management planning is more important now than ever before because water pollution problems are more numerous and complex, and the resources to deal with them are diminishing. Managers are faced with setting priorities, improving efficiency, and applying controls for maximum effect.

The following describes the recent accomplishments of the 208 program in Montana and explores directions for the future.

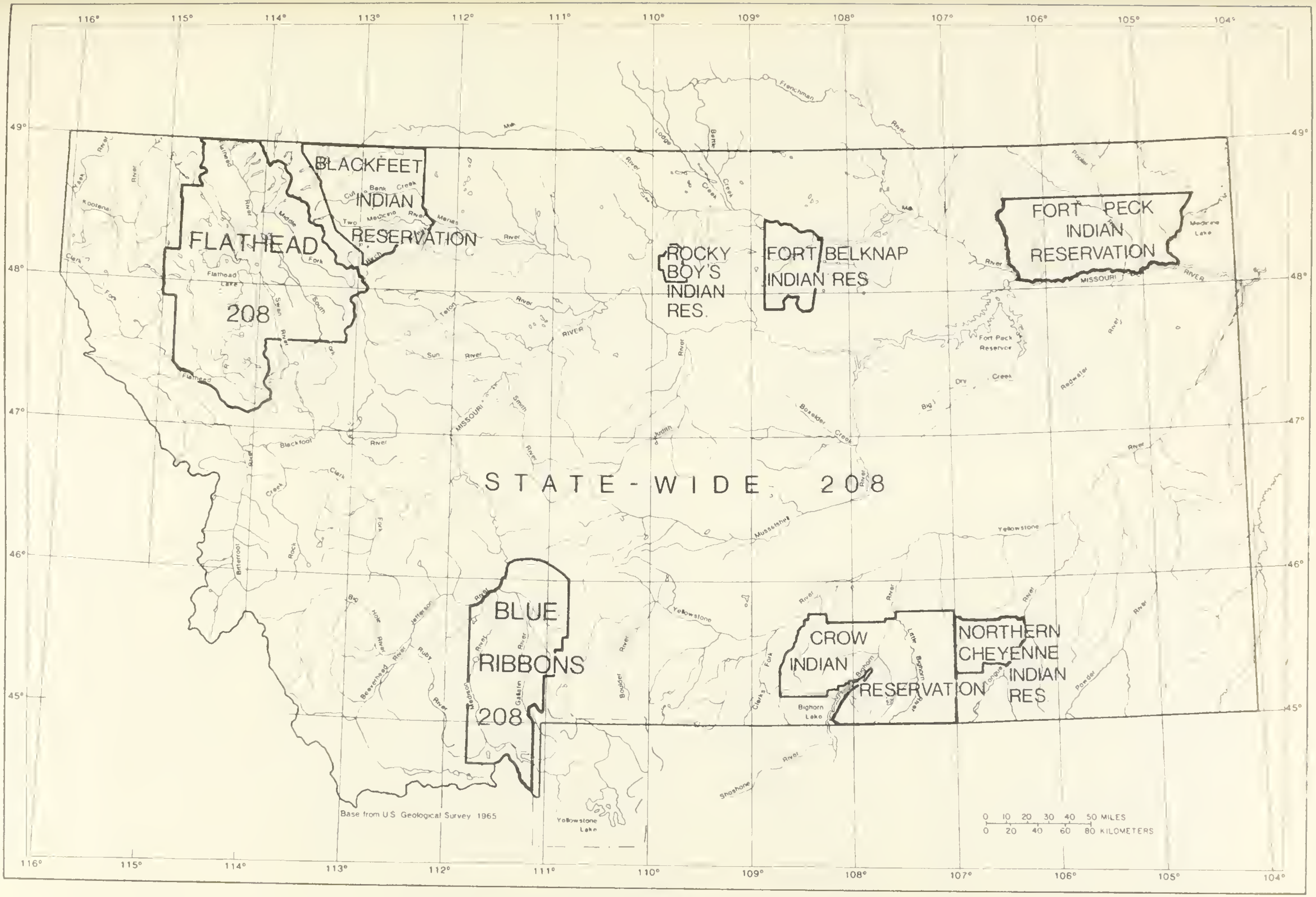


FIGURE 7. WATER QUALITY MANAGEMENT PLANNING AREAS.

STATEWIDE

Water quality management planning in Montana, exclusive of the two designated 208 areas, is the responsibility of the WQB. Planning and monitoring are the principal functions of the WQB's Water Quality Management section.

The 1979 Statewide Water Quality Management Plan provided the framework for water quality management in Montana. The plan delegated certain management responsibilities to government land and resource management agencies. The plan was implemented through agency cooperative agreements and 208 planning grants.

Recent statewide planning activities have been principally in agriculture, forestry and mining, the three industries responsible for most of the nonpoint source water pollution in Montana.

AGRICULTURE

County soil and water conservation districts were designated in the 208 Plan as the local agents for controlling agriculture-related pollution. Cooperative agreements were signed with all 59 conservation districts.

In 1980 and 1981, the WQB made grants to six county conservation districts to assist with correcting nonpoint source problems: a) Cascade County, Muddy Creek, b) Lewis & Clark County, Prickly Pear Creek, c) Hill County, Beaver Creek, d) Jefferson Valley, Pipestone Creek, e) Carbon County, Bluewater Creek, f) Green Mountain, Sediment Control Ordinance.

Installation of fencing, check dams and bank stabilization structures has been completed on Bluewater Creek to correct a long standing sedimentation problem. The Cascade and Lewis and Clark County projects have been extended into 1983. An additional grant was made in 1982 to the Rosebud County Conservation District to determine the effects of irrigation management on return flow water quality. Assistance was also given to the Park County Conservation District in conducting a streambank physical features inventory on the Shields River.

In 1979 the Montana Bureau of Mines and Geology was hired by the WQB to investigate the water quality impacts of draining saline seeps in selected seep-prone areas of the state. The final report was completed in 1981.

More than 800 miles of Montana streams experience severe water depletion by irrigation withdrawals. In 1978 the DHES received an instream flow reservation on the Yellowstone River to protect the quality of drinking water supplies. Recently the WQB has been monitoring water development activities on the Yellowstone to ensure they do not interfere with the DHES reservation. The WQB has also prepared a draft application for an instream flow reservation on the Clark Fork River and ranked streams in order of priority for future reservations.

For several years the WQB has contracted with the Conservation Districts Division, DNRC, to assist county conservation districts in solving their water quality problems. The contract has been extended, for a final time, to June 30, 1983. An additional responsibility will be to help the districts with problems involving the administration of the Natural Streambed Land Preservation Act, also known as the "310 law." The Conservation Districts Division Resource Conservation Plan for 1981-1985 lists three water quality objectives: 1) Work with DHES and districts on six water quality management planning projects, 2) assist districts in obtaining funding to implement water quality improvements and 3) help districts identify streams that need streambank inventories and request assistance to complete the inventories.

In 1980 the DHES signed a cooperative agreement with the Department of the Interior's BLM designating the federal agency as the nonpoint source pollution control agent on lands under its jurisdiction in Montana. BLM provides yearly status reports on pollution problems and control efforts. These reports were used to identify problem segments for the severity analyses presented at the beginning and end of this report. BLM and the WQB work jointly to solve water problems on BLM lands.

FORESTRY

Early in 1982 the DHES signed an interagency agreement with the Forestry Division of the DSL. The Forestry Division has hired a training specialist who will work to educate loggers and private forestland owners on timber harvest techniques that protect water quality. The EPA and the WQB helped the Forestry Division develop a training program oriented to Montana forestry problems.

In 1979, DHES and Region One of the Forest Service signed a cooperative agreement designating the federal agency as the nonpoint source pollution control agent on lands under its jurisdiction in Montana. Under this agreement, the Forest Service provides biennial reports on water quality problems, priorities and accomplishments in national forests. In 1982 the Regional Office provided the WQB a list of priority watershed improvement projects to be coordinated with the WQB and summaries of other forest projects. Two forests—the Gallatin and the Kootenai—recently produced comprehensive stream-by-stream water quality interpretations based on available data.

MINING

An agreement was signed early in 1982 with the DSL to help prevent serious sedimentation problems from the burgeoning number of placer mines in Montana. Funding was provided by DHES to produce a handbook for miners describing how to construct settling ponds. Other objectives of this agreement are described in the section on placer mining under Special Problems.

OBJECTIVES

Statewide water quality management planning likely will be without federal funding after June 30, 1983, even though the mandate for planning and nonpoint source pollution control remains in Section 208 of the Federal Water Pollution Control Act as well as in sections of the Montana Water Quality Act. Planning funds were never adequate, and implementation funds have been almost nonexistent. This has been the greatest frustration facing those who work on nonpoint source pollution control.

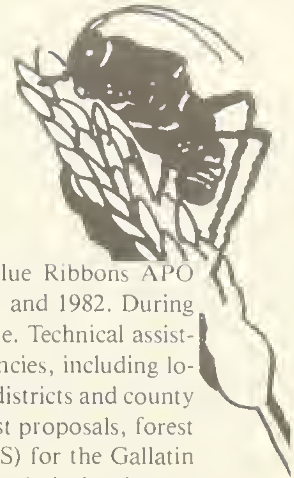
As pollution control and other environmental programs enter the lean times ahead, cleanup efforts will have to be prioritized and programs streamlined to get the maximum effect from limited resources. Water quality managers will need to be more resourceful in obtaining feasibility and implementation funds. Federal programs, like the Agricultural Conservation Program and the Abandoned Mine Land Program, and state programs, like the Renewable Resources Development and Water Development programs, and line-item legislative appropriations will become increasingly important in efforts to correct nonpoint source pollution problems in Montana.

Without funding support from the legislature to replace lost EPA planning funds, the WQB will not be able to continue the comprehensive water pollution control program required by the Montana Water Quality Act. As the severity analysis at the beginning of this report shows, nonpoint source pollution problems are far more numerous and severe than point source problems in Montana. With some replacement funding, the WQB will be able to help conservation districts and others under the Statewide Plan to identify nonpoint source problems and to find funding to correct them. With some replacement funding, the Water Quality Management Section will also be able to provide the WQB's other pollution control programs with the monitoring and technical support that had been funded by the EPA under Section 208.

AREAWIDE

The Mid-Yellowstone and Yellowstone-Tongue Areawide Planning Organizations discontinued their water quality planning activities in 1979 and 1980, respectively. The Flathead Drainage 208 project encompassing Flathead, Lake and a portion of Sanders County in northwestern Montana continued efforts in 1981 and 1982. However, its activities are expected to conclude in the fall of 1982. The Blue Ribbons of the Big Sky Country Areawide Planning Organization (APO) continued efforts in 1981 and 1982, and is expected to conclude formal 208 related activities in the summer of 1983. The recent activities of these remaining areawide 208 projects will be summarized.

Montana Travel Promotion Bureau



BLUE RIBBONS 208

Water quality planning activities of the Blue Ribbons APO continued with a reduced level of effort in 1981 and 1982. During these years the project director worked part-time. Technical assistance was given to the 13 local management agencies, including local, city and county governments, conservation districts and county and city-county planning boards. Timber harvest proposals, forest plans and environmental impact statements (EIS) for the Gallatin and Beaverhead national forests were reviewed. Technical assistance and data were provided for a Gallatin National Forest water quality summary. Land management proposals and EIS's of the BLM were reviewed. Efforts continued to keep the public aware of local water quality issues.

The project director is also involved in special projects, such as the lower Madison River Thermal Study. This study involves the evaluation of alternatives for correcting an elevated water temperature problem in the Madison River below Ennis Lake. This problem has caused degradation of the fishery in this nationally prominent blue ribbon trout stream. Consultants have been retained and cost estimates and feasibility studies for six alternatives have been initiated. The director is also chairman of a Madison River Committee which is investigating various means to protect the upper Madison River (above Ennis Lake) from adverse encroachment and development. Review of BLM land management proposals (half of the land bordering the upper Madison River is owned by BLM) and development and encouragement of conservation easements by private landowners are some of the activities of this committee. The Blue Ribbons director is also involved in continuing stream influence and urban runoff studies in Bozeman.

FLATHEAD DRAINAGE 208

Water quality planning and review activities of the Flathead Drainage 208 project continued in 1981 and through the spring and summer of 1982. These activities are expected to formally conclude in autumn of 1982. Among the activities during this period are the following.

—An irrigation scheduling and management study for the Mission, Post and Crow Creek drainages continues in Lake County. The intent of the study is to upgrade water quality in these drainages by reducing erosion through improved irrigation practices and scheduling.

—A groundwater study in the Somers/Juniper Bay area of Flathead Lake continued. Contaminant levels in local wells were identified, sources of pollution were investigated and hydrogeological characteristics of the fractured limestone bedrock formations in the area were studied.

—Technical assistance to local management agencies was provided. The communities of Lakeside, Ronan, Hot Springs and Kalispell were assisted with their wastewater facilities planning.

—The three Flathead drainage area conservation districts were assisted.

—Regulations affecting the area were reviewed, including the Flathead County Lakeside Protection Regulations and the state's proposed groundwater protection regulations.

—Efforts at maintaining public awareness of water quality issues in the basin were continued. The Hungry Horse-West Glacier Highway expansion project was one of the more controversial issues.

—Efforts to establish joint application for environmental, sanitation and planning board review of subdivision and development activity for Flathead County succeeded, and has been implemented.

—A Whitefish Clean Lake Committee was established and efforts are being made to develop and fund a Whitefish Lake protection study.

—Review of Flathead National Forest activities continued.

—Water quality related activities were coordinated with the Confederated Salish-Kootenai Tribes.

—Technical assistance was provided to the state's and the EPA's examination of groundwater contamination in the Evergreen area. This area is being studied for potential inclusion on the national priorities list for Superfund.

INDIAN 208 PROGRAMS

Several 208 water quality management planning efforts were initiated on Montana Indian Reservations in 1978. Water quality planning considerations for the Flathead Reservation (Confederated Salish-Kootenai Tribes) are addressed by the Flathead Drainage 208 project.

The Crow and Northern Cheyenne reservations were originally included in the Mid-Yellowstone and Yellowstone-Tongue areawide planning areas, respectively. The Northern Cheyenne Tribe has since received separate 208 funds for water quality planning. The Northern Cheyenne are attempting to develop a water quality management plan with tribal resources. The plan is expected to be completed in the fall of 1982. The Crow Tribe has also received separate 208 funds, and has hired consultants to compile existing water quality assessments, inventories and management strategies into a useful water quality management plan. This is expected to be finished in early 1983.

The Rocky Boy's Indian Reservation completed an assessment in 1979 of water quantity investigations and potential water storage and diversion sites. Further water quality planning activities have not occurred.

The Fort Belknap Indian reservation initially used 208 funds in 1978 and 1979 to investigate domestic well contamination and the effects of mine tailings on surface waters. In 1980 and 1981 the reservation was to establish baseline water quality conditions and to identify point and nonpoint pollution sources. This has not been done.

The Blackfeet Indian reservation used 208 funds to contract with the U.S. Fish and Wildlife Service to develop a water quality management plan. This plan was completed in the spring of 1982. The comprehensive plan includes detailed water quality inventories for streams and lakes on the reservation as well as assessments of various strategies to deal with streambed alterations, lakeshore uses, forestry practices, oil and mineral exploration, livestock operations, sewage facilities, pesticide usage and municipal problems. Also included are recommendations for instream flow reservations, water use descriptions, and water classifications and standards.

The Fort Peck reservation (Assiniboin and Sioux tribes) operate a continuous water quality planning program. Fort Peck was the first reservation in the country to enter into an agreement with EPA for the coordination and management of environmental programs. The tribal Office of Environmental Protection (OEP) has identified most existing and potential surface water quality problems, inventoried all water wells near the Poplar oil fields, and entered into a cooperative agreement with the USGS to conduct a comprehensive ground and surface water quality study in the areas adjacent to the fields. The USGS will provide tribal OEP staff with technical training in sampling techniques and study design to enable the tribe to set up and maintain a permanent monitoring network. The Bureau of Indian Affairs (BIA) and the OEP have also set up a joint monitoring effort to identify and map the saline seep areas on the reservation.

The Fort Peck tribes, through the OEP, are also developing codes and classifications for reservation waters, drafting their Water Quality Management Plan and researching means for regulation and enforcement.

goals and attainment

Back in 1972, Congress set two goals in the Federal Water Pollution Control Act:

1. Make waters swimmable and fishable by 1983; and

2. Eliminate the discharge of pollutants by 1985.

The first of these goals comes due next year. The WQB's next water quality assessment won't be prepared until 1984, so now is the last chance to assess progress toward the 1983 goal. It has been criticized as being hopelessly naive and unrealistic, but it should be remembered for what it is—a goal.

Most of Montana's water quality problems originate on the land—the dry, salt-rich and erosive lands that make up a large part of the state. Superimposed on these lands are modern, resource-based industries which, in some cases, have greatly accelerated natural water depletion, salinization, erosion and sedimentation.

Serious work on these soil and water conservation problems began after the drought-filled "Dirty Thirties." But progress has been painfully slow. New technologies, one of them (fallow farming) hailed as the solution to soil erosion and crop failure on the northern plains, have created new problems (saline seep). Modern machinery makes it possible for one person to move more soil, clear more trees and extract more ore in a single day than ever thought possible 50 years ago. New problems appear as present ones remain relatively unsolved.

By far the greatest barrier to cleaning up these nonpoint-source pollution problems is the severe shortage of funds to implement water quality improvement practices. As the National Association of Conservation Districts said in a recent report: *"The main restraint to our nation's nonpoint source water quality improvement effort... is still the shortage of physical and financial resources needed to solve actual water quality problems. Being aware of problems and developing plans to solve them doesn't clean up the water."*

Another problem is the shortsighted attitude of using stopgap measures. Instead of long-term, on-the-farm improvements, the federal government many times has opted for large structural remedies. To correct the severe soil erosion and sedimentation problem along Muddy Creek—Montana's worst water quality problem—the U.S. Bureau of Reclamation proposes to construct a $19 million dam at Power. Dams collect and fill with silt; they don't encourage the conservation of soil and water resources on the farm.

The picture is not all bleak. A host of government agencies and local water quality improvement projects is chipping away at the backlog of problems. Water pollution control structures have already been installed along Bluewater Creek in Carbon County to correct a long-standing streambank erosion problem. Farmers along Pipestone Creek in Jefferson County have a plan in hand for managing a similar problem and they likely will be approaching the 1983 Legislature for implementation funds. Nevertheless, without a massive infusion of implementation funds, there is little hope for a general improvement in water quality statewide.

There's better news on point-source pollution control. Six stream segments listed in the 1976 water quality report as impaired by municipal wastewater discharges were eliminated as problems for this year's report either because of improved treatment provided by upgraded facilities or because of greater resolution of the instream effects, achieved by intensive surveys:

1. Bitterroot River below Darby
2. Bitterroot River below Stevensville
3. East Gallatin River below Manhattan
4. Little Dry Coulee below Conrad
5. Missouri River below Townsend
6. Old Maid Coulee/Cut Bank Creek below Cut Bank

Fourteen potential problem segments listed at the end of this report scored a severity index rating of zero, meaning "no problem." (However, some of these nonproblems will need to be confirmed with followup surveys.) One of these is McDonald Creek below Winnett, a town that has upgraded its wastewater treatment facilities with funds from the Construction Grants Program. But more than 200 stream segments remain in Montana that apparently will not meet the 1983 fishable and swimmable goal. The list probably won't be much shorter when the next report is written in 1984, but, with adequate funding for the pollution control programs described in this report, the list shouldn't be any longer.

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appendix

Supplemental Information

The geography that restricts water to certain courses is commonly called a drainage basin. Much of the information in this report refers to these geographically distinct areas.

The three major basins--the Clark Fork, Missouri and Yellowstone--are so large and diverse they have been divided into parts.

Montana's sixteen basins are a convenient way to organize stream water quality problems. For each basin we present 1) a brief narrative description of physical features and natural water quality, 2) a list of apparent and potential problem stream segments, and 3) a map showing principal towns and water bodies plus the location of each problem segment. The following is an explanation of the abbreviations used in the basin lists of apparent and potential problem segments:

Impaired Uses

A	Aquatic life
I	Irrigation
L	Livestock watering
P	Public water supply
R	Recreation

Pollutants

As	Arsenic
B	Boron
BOD	Biochemical oxygen demand
C	Coliforms (bacteria)
Cl	Chloride
DO	Dissolved oxygen
F	Fluoride
Gases	Dissolved gases
Giardia	Giardia lamblia (Pathogenic intestinal parasite)
H2S	Hydrogen sulfide
Metals	Copper, iron, lead, zinc, etc.
N	Nitrogen
NH3	Ammonia
Oil	Oilfield production waste
P	Phosphorus
pH	Acidity
Phenols	Refinery waste products
SO4	Sulfate
TDS	Total dissolved solids (salinity)
Temp	Temperature
TSS	Total suspended solids (sediment)

Pollution Sources

A	Agriculture (multiple practices)
C	Construction
DA	Dryland agriculture
F	Forest practices
G	Grazing
HM	Hydrologic modification
I	Industrial discharge
IA	Irrigated agriculture
IM	Inactive mining
M	Mining (exploration or production)

N	Natural
O	On-site domestic waste disposal
P	Petroleum (oil and gas) exploration or production
U	Urban runoff
WWTP	Wastewater treatment plant

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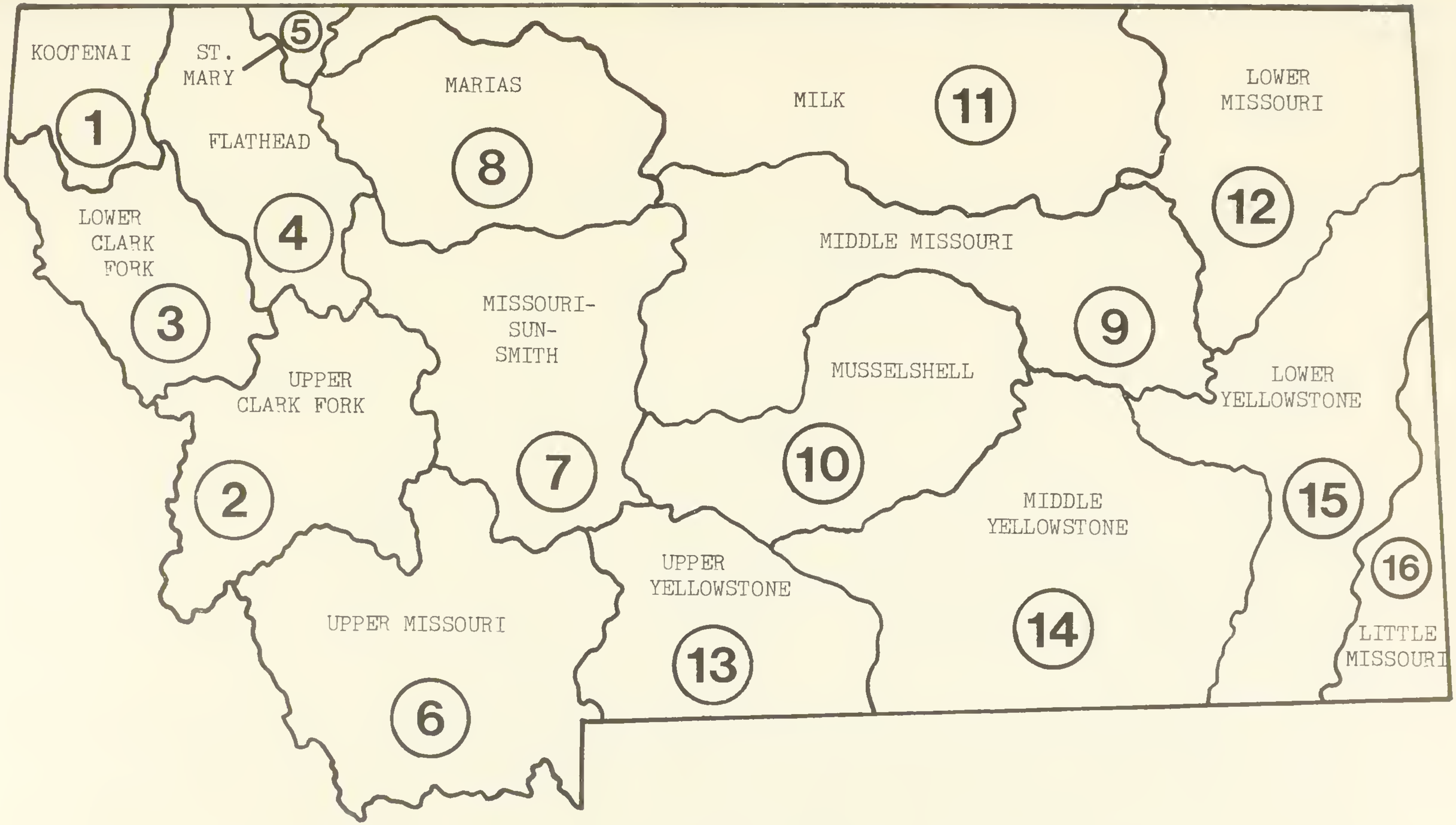
Severity Index Qualifiers

A	Downstream use(s) impaired
B	Improved water quality attainable
C	Large population affected
D	Valued resource affected
E	Interstate, national or international issue
F	Local interest and involvement
G	Unnatural flow fluctuation


KOOTENAI
1
ST. MARY
5
FLATHEAD
4
LOWER CLARK FORK
3
UPPER CLARK FORK
2
MARIAS
8
MISSOURI-SUN-SMITH
7
UPPER MISSOURI
6
MILK
11
MIDDLE MISSOURI
9
MUSSELSHELL
10
UPPER YELLOWSTONE
13
LOWER MISSOURI
12
LOWER YELLOWSTONE
15
MIDDLE YELLOWSTONE
14
LITTLE MISSOURI
16

1 - KOOTENAI RIVER BASIN

The Kootenai River Basin is a well-watered region of steep, heavily timbered mountains and narrow valleys. The area is sparsely inhabited and contains few industries and communities. Timber harvest, mining and tourism are the primary commercial activities. Agriculture is a relatively minor pursuit in the basin.

A major hydroelectric installation--Libby Dam--has turned a good share of the once free-flowing Kootenai River into slack water. Other hydroelectric developments on the Kootenai are contemplated, and a major copper mining and milling facility is in operation near Troy.

Precipitation in the basin is about 24 inches per year in the valleys to more than 80 inches a year in the mountains. Elevations in the basin range from nearly 9,000 feet in the Cabinet Mountains to about 1,800 feet near Troy, the lowest point in Montana.

Forest soils present a moderate to severe erosion hazard. Commercially attractive copper and vermiculite deposits have prompted exploration and mining. Roadless and wilderness areas attract increasing numbers of visitors each year.

The Kootenai River Basin includes some of the purest waters in America; concentrations of dissolved chemicals are among the lowest in Montana. Streams are significantly less productive and potentially more sensitive to acid mine drainage and heavy metals pollution than streams elsewhere in Montana.

Map No.	Stream Segment	Drainage	Probable Impaired Use(s)	Suspected Pollutants	Pollution Sources	Reference Nos.	Severity Index	
1	Fisher R.	Kootenai R.	A	TSS	N,A,C,HM,F,G	1,3,4,5	0.20	F,G
2	Keeler Cr.	Lake Creek	A	TSS	F,N	11		B,G
3	Kootenai R. below Libby Dam	Kootenai R.	A,L,R	Gases,C	HM,Libby WWTP	3,7	0.39	B,D,G
4	Snowshoe Cr.	Big Cherry Cr.	A	Metals	M	1,4	0.0*	

*Zinc concentrations in Snowshoe Cr. are toxic to aquatic life, but the effect of zinc on aquatic life was not a factor in calculating the severity index.


Eureka
Lake Koocanusa
Yaak River
Troy
KOOTENAI RIVER
Libby
1
2
3
4
Fisher River
N
KOOTENAI RIVER BASIN
0 10 20 Miles

2 - UPPER CLARK FORK RIVER BASIN

The Upper Clark Fork River Basin contains moderately timbered and highly mineralized mountain ranges separated by broad agricultural valleys.

Elevations in the drainage range from over 10,000 feet in the Anaconda Range to slightly more than 3,000 feet near Missoula. Total precipitation generally increases with elevation, with more snowfall in the mountains. Valley precipitation varies from 8 to 20 inches annually, most of it falling in the late spring and early summer.

The basin comprises an area of 6,115 square miles or nearly four million acres of land. Forests cover 2.3 million acres, pasture and range 880,000 acres, urban and built-up areas 54,000 acres and lakes and impoundments 9,700 acres. Irrigated cropland covers 150,000 acres of the basin and dry cropland exceeds 23,000 acres. Irrigated agriculture accounts for the largest use of water in the basin; total diversion requirements for irrigation approach 500,000 acre-feet per year with a net depletion of nearly one-half that amount.

Water quality varies considerably within the basin. Silver Bow Creek below Butte has some of the worst water quality in the state, while Rock Creek near Missoula is considered by many as a "blue ribbon" trout fishery. Pristine, nearly sterile, high mountain lakes dot some of the higher mountain ranges in the basin, while eutrophic Georgetown Lake near Anaconda is probably the most productive fishery in Montana.

Map No.	Stream Segment	Drainage	Probable Impaired Use(s)	Suspected Pollutants	Pollution Sources	Reference Nos.	Severity Index	
1	Blackfoot R. to Lincoln	Clark Fork R.	A,R	TSS,Metals,pH	IM,F	3,4		
2	Braziel Cr.	Nevada Cr./ Blackfoot R.	A	TSS	F	2		B
3	Brock Cr.	Clark Fork R.	A,R	TSS,P	M,N	3	2.60	
4	Camas Cr.	Union Cr./ Clark Fork R.	A,R	TSS,C,N,P	G,C	2		
5	Clark Fork R. from Warm Springs to Garrison	Clark Fork R.	A,R	Metals,N,P BOD,pH	Anaconda WWTP Butte WWTP Deer Lodge WWTP Warm Springs WWTP M,IM,IA,U,I	1,3,4,6,7,8	2.41	A,B,C
6	Clark Fork R. from Garrison to Bonner	Clark Fork R.	A,R	Temp,DO,N,P	Anaconda WWTP Butte WWTP Deer Lodge WWTP Warm Springs WWTP N,C,HM	1,2,3,7	1.28	B,C
7	Cottonwood Cr.	Douglas Cr./ Blackfoot R.	A,R	TSS,C,N,P	G	2,3		G
8	Deep Cr.	Bear Cr./ Clark Fork R.	A,R	TSS,C,N,P	G	2		
9	Douglas Cr.	Nevada Cr./ Blackfoot R.	A,R	TSS	C,G,M	2,3,4,5	0.91	B,F
10	Dunkelburg Cr.	Clark Fork R.	A,R	pH,TSS,Metals	IM	4	1.97	
11	Elk Cr.	Blackfoot R.	A	TSS	M,G.	2,3,4		B
12	Flint Cr.	Clark Fork R.	A,R	DO,H2S,TSS Metals	HM,IM,IA	3,4	0.84	G
13	Gold Cr.	Clark Fork R.	A,R	TSS	F,IM	3,4	1.28	
14	Kennedy Cr.	Elk Cr./ Blackfoot R.	A,R	TSS,C	G	2		B
15	Keno Cr.	Elk Cr./ Blackfoot R.	A	TSS	F	2		B
16	Lander's Fork	Blackfoot R.	A	TSS	N,F,G	3,4		
17	McElwain Cr.	Nevada Cr./ Blackfoot R.	A	TSS	F	2		B

18	Mud Spring Cr.	Washoe Cr./ Union Cr.	A,R	TSS,C,N,P	G	2		
19	Murray Cr.	Douglas Cr./ Blackfoot R.	A,R	TSS	G	2		
20	Nevada Cr.	Blackfoot R.	A,R	TSS	A,F	3,4,5,11	1.86	F,G
21	North Fork Blackfoot R.	Blackfoot R.	A	TSS	N	3		
22	Rock Cr.	Clark Fork R.	A	TSS,N,P	HM	11		B,D
23	Scotchman Cr.	Willow Cr./ Rock Cr.	A	TSS	C	2		B
24	Silver Bow Cr.	Clark Fork R.	A,I,L,R	SO4,TDS,Metals, N,P,pH,BOD	Butte WWTP M,IM,U,I	1,3,4,6,7,8	24.26	A,B,C,F
25	Union Cr.	Blackfoot R.	A	TSS,Metals	A,IM	2,3,5	0.0	B,F
26	Wallace Cr.	Clark Fork R.	I	TSS	?	2		
27	unnamed creek	W. Fork Rock Cr.	A	TSS	G	2		B


River
Blackfoot
Bonner
Clark Fork River
Deer Lodge
Clark Fork R.
Anaconda
Butte
N
UPPER CLARK FORK RIVER BASIN
0 10 20 30 40 Miles
1
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3
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3 - LOWER CLARK FORK RIVER BASIN

The Lower Clark Fork River Basin, along the western border of Montana, comprises an area of 8,900 square miles or over 5.5 million acres. This basin includes 1,900 square miles of the Flathead River drainage below Flathead Lake, 2,800 square miles in the Bitterroot River drainage, and all of the Clark Fork River drainage below the Blackfoot River.

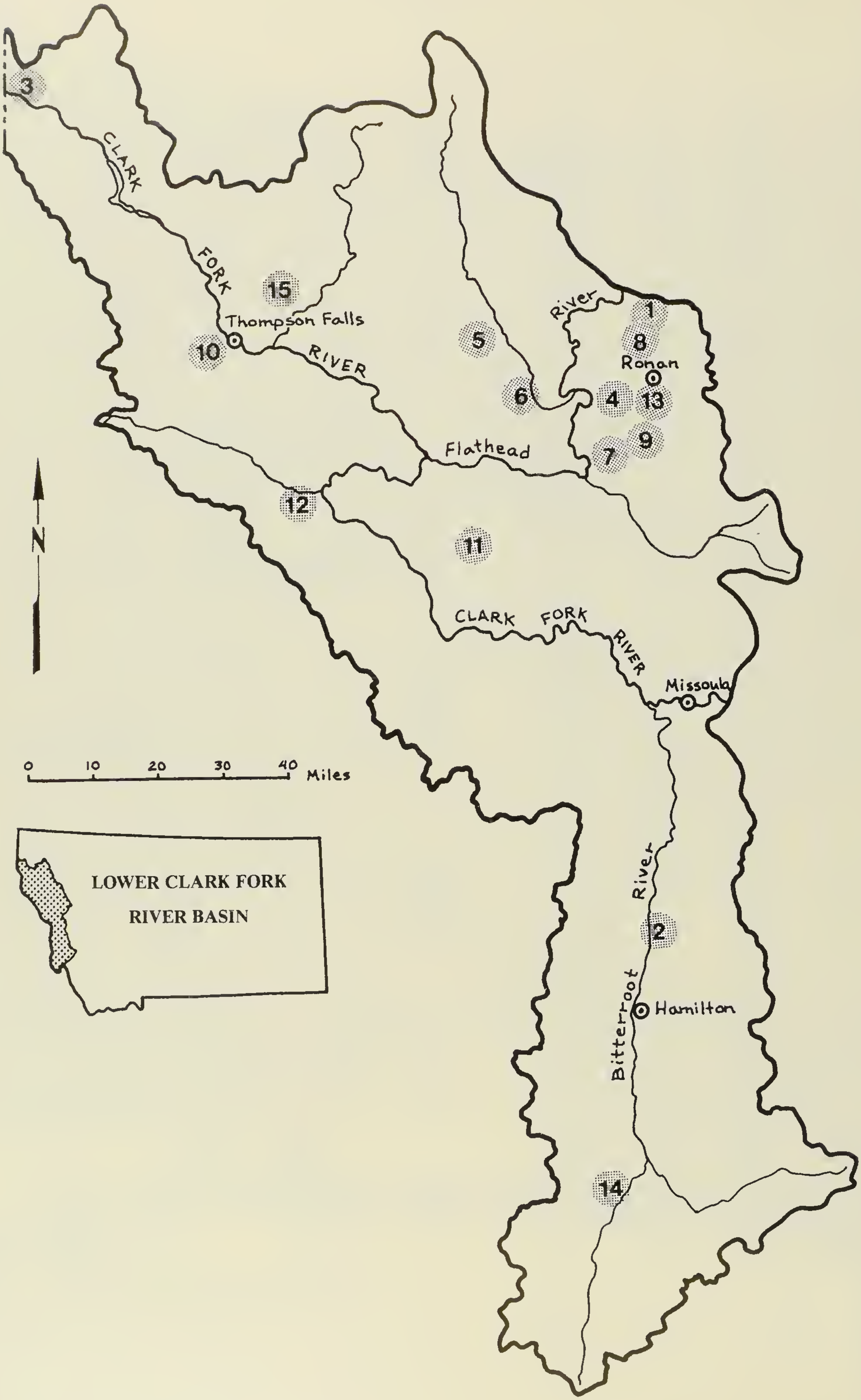
About 60 percent of the basin is in federal ownership, mostly national forest land. Cropland covers about 400,000 acres, two-thirds of which is irrigated. Principal industries in the basin are agriculture, tourism, logging and forest products.

The climate in the Lower Clark Fork River Basin is variable, depending on elevation. Annual precipitation ranges from less than 10 inches southwest of Flathead Lake to more than 40 inches in the higher mountains. Elevations in the basin range from more than 10,000 feet in the Bitterroot Range to about 2,000 feet where the Clark Fork River enters Idaho.

Although it accounts for only about 15 percent of the land area, agriculture is by far the largest water user in the basin. Annual diversion requirements for irrigation approach 1.6 million acre feet of water with a net depletion of 760,000 acre feet per year.

Water quality is variable. Generally, rivers and streams flowing through concentrated agricultural areas are degraded, with temperatures, dissolved solids and other variables indicating the effects of irrigation diversions and return flows. Municipal and industrial effects are present but subdued. Streams flowing through remote areas have excellent water quality tempered only by the effects of seasonal runoff. Water entering the basin near Missoula still retains some effects of municipal and industrial waste discharges far upstream in the Butte-Anaconda-Deer Lodge area.

Map No.	Stream Segment	Drainage	Probable Impaired Use(s)	Suspected Pollutants	Pollution Sources	Reference Nos.	Severity Index	
1	Bisson Cr.	Flathead R.	A	TSS	IA	3		
2	Bitterroot R. below Hamilton	Clark Fork R.	A,R	TSS,C	IA,O,A, Hamilton WWTP	3,5	1.12	C,F,G
3	Clark Fork R. below Noxon and Cabinet Gorge Dams	Clark Fork R.	A	Gases	HM	3		
4	Crow Cr.	Flathead R.	A,I,R	TSS,C,N,P,DO,NH3	IA,Ronan WWTP	1,6,7	5.47	B,F
5	Hot Springs Cr. below Hot Springs	Little Bitterroot R.	A,R	TSS,C,Temp,N,P	Hot Springs WWTP N,G,A	1,3,5,6,7		F
6	Little Bitterroot R.	Flathead R.	A	TSS,C	N,A	3,5		F,C
7	Mission Cr.	Flathead R.	A,I,R	TSS,C,N,P	IA	1,6	5.11	B,F
8	Mud Cr.	Crow Cr.	A,R	N,P	IA,O	3		
9	Post Cr.	Mission Cr.	A,I,R	TSS,C,N,P	IA	1,6	3.14	B,F
10	Prospect Cr.	Clark Fork R.	A	TSS	C,F	3	C	
11	St. Louis Cr.	Ninemile Cr.	A	TSS,Metals	IM	11		B
12	St. Regis R.	Clark Fork R.	A	TSS	IM	11		B
13	Spring Cr.	Crow Cr.	A,R	N,P	IA,O	3		
14	W. Fork Bitterroot R.	Bitterroot R.	A	TSS	A,F	3		G
15	W. Fork Thompson R.	Thompson R.	A,R	TSS	F	3	0.10	


CLARK
FORK
RIVER
Thompson Falls
Flathead
River
Ronan
CLARK FORK RIVER
Missoula
Bitterroot River
Hamilton
N
0 10 20 30 40 Miles
LOWER CLARK FORK
RIVER BASIN
1
2
3
4
5
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7
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15

4 - FLATHEAD RIVER BASIN

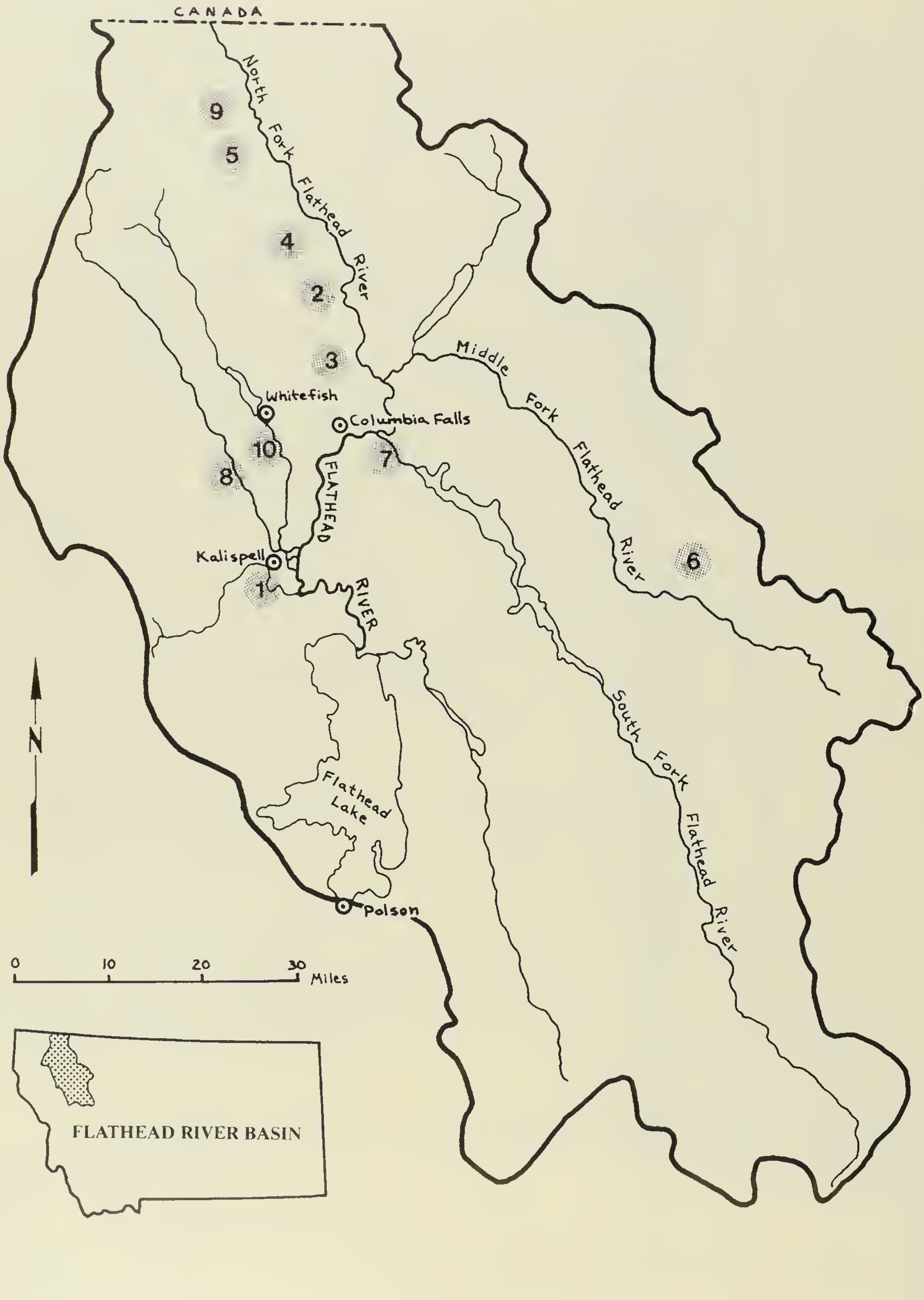
The Flathead River Basin drains much of northwestern Montana. It extends south from the Canadian border, west from the Continental Divide, north from the lower end of Flathead Lake and east from the Whitefish and Salish mountains.

The region is largely mountainous and forested, with timber harvest the principal industry and agriculture restricted to the mostly narrow valley bottoms. The one notable exception is the broad north-south trough that contains Flathcad Lake and the agricultural/commercial heart of the basin: the Flathead Valley. Most of the basin is sparsely inhabited except for the area around Kalispell, which is at the center of one of the fastest growing regions of Montana.

Elevations in the drainage range from more than 10,000 feet in Clacier National Park to about 2,900 feet on Flathead Lake. The climate is moist and cool, influenced both by Pacific weather systems from the west and by the stabilizing effect of the 183 square mile Flathead Lake. Annual precipitation varies from over 50 inches in the mountains to about 20 inches in the Flathead Valley.

As a headwater drainage of the Clark Fork-Columbia River system, the Flathead has some of the purest waters in America. With few exceptions, waters in the basin are suitable for all beneficial uses following minimal treatment. Water quality problems are usually associated with surface disturbances, concentrations of livestock or people, and with large hydroelectric dams. Forestry and agriculture are the primary land-disturbing activities. Canadian coal development across the border in British Columbia portends water quality impacts on the North Fork of the Flathead River.

Map No.	Stream Segment	Drainage	Probable Impaired Use(s)	Suspected Pollutants	Pollution Sources	Reference Nos.	Severity Index	
1	Ashley Cr.	Flathead R.	A,R	C,N,P,NH3	Kalispell WWTP O,A	3,5,6,7	5.90	A,B,C D,F
2	Big Cr.	N. Fork Flathead R.	A	TSS	F	3	0.0	D
3	Canyon Cr.	N. Fork Flathead R.	A	TSS	F	3	0.0	D
4	Coal Cr.	N. Fork Flathead R.	A	TSS	F	3		D
5	Red Meadow Cr.	N. Fork Flathead R.	A	TSS	F	3		D
6	Skyland Cr.	Bear Cr./M. Fk. Flathead R.	A	TSS	F	11		B
7	S. Fork Flathead R.	Flathead R.	A,R	Temp	HM	3	0.0	A,D,C
8	Stillwater R. below Logan Cr.	Flathead R.	A,R	TSS,N,P	IA,F,O,A	1,3,5	0.80	F,C
9	Whale Cr.	N. Fork Flathead R.	A	TSS	F	3		D
10	Whitefish R. below Whitefish Lake	Flathead R.	A,R	TSS,N,P	IA,U Whitefish WWTP,O	1,3,7	1.57	B,C


CANADA
North Fork Flathead River
Middle Fork Flathead River
South Fork Flathead River
FLATHEAD RIVER
Flathead Lake
Whitefish
Columbia Falls
Kalispell
Polson
9
5
4
2
3
10
8
7
1
6
N
0
10
20
30
Miles
FLATHEAD RIVER BASIN

5 - ST. MARY RIVER BASIN

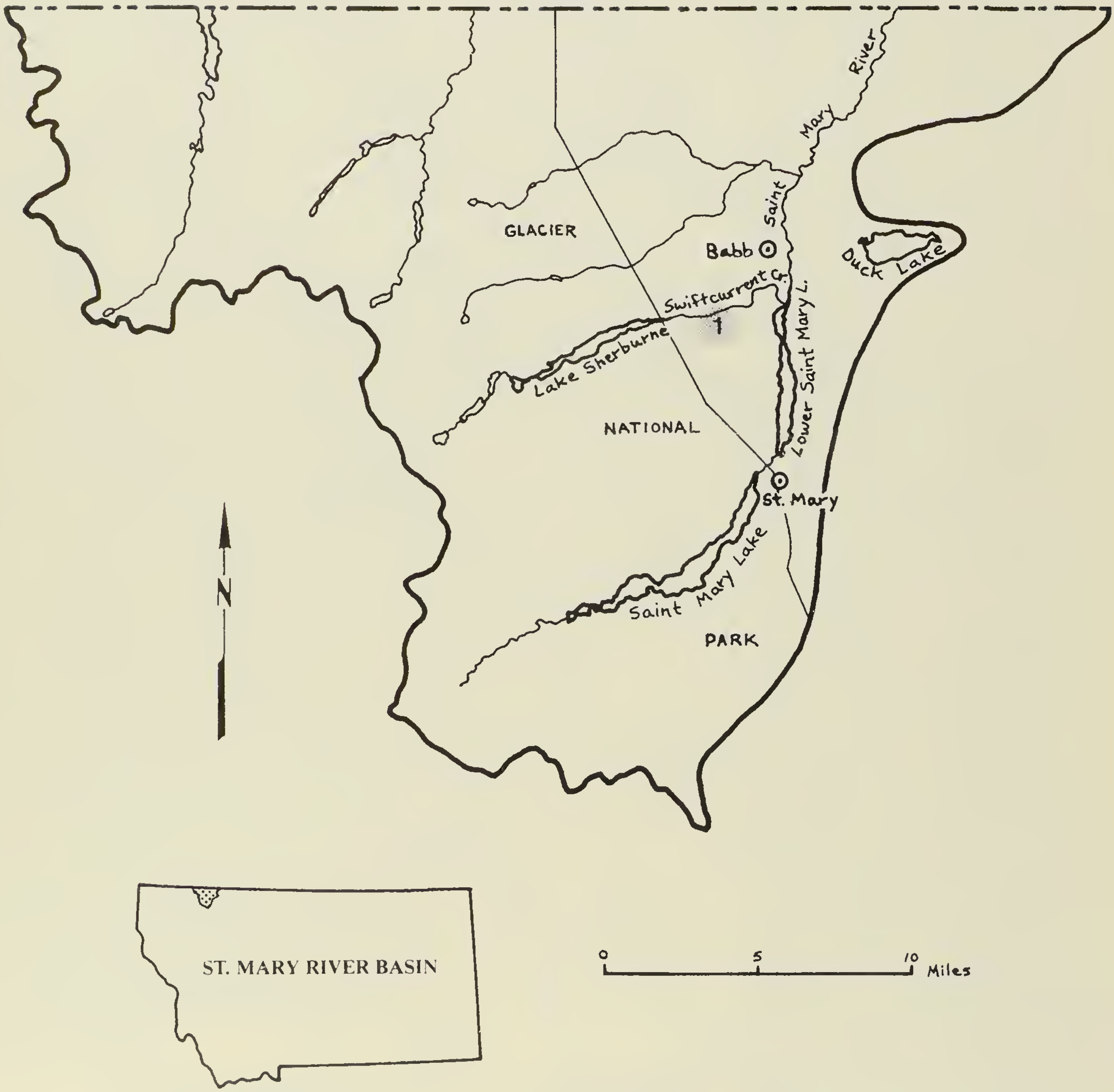
The St. Mary River Basin is less than one percent of the total land area in Montana. Seventy percent of the basin is in Glacier National Park and 30 percent on the Blackfeet Indian Reservation. The waters form the headwater of Canada's Saskatchewan River system, which drains north and east to Hudson's Bay. Physical characteristics in the basin include the spectacular mountains, glaciers and glacial lakes in Glacier Park, forested hill terrain at lower elevations, and rolling rangeland in the St. Mary River Valley. Elevations in the drainage range from more than 10,000 feet in Glacier National Park to less than 4,500 feet at the international border. Climate is dependent on elevation. Rainfall varies from 120 inches a year in the mountains to 20 inches a year on the prairie. Temperature extremes are generally more pronounced at lower elevations, particularly under the influence of chinook winds in the winter.

The quality of waters in the St. Mary drainage basin is generally excellent. Population in the basin is sparse, and wastewater discharges few and minor. The primary land use outside Glacier Park is grazing and only a small fraction of the drainage is farmed. The two principal stream segments in the basin are the Belly and the St. Mary rivers.

The Belly River drainage in Montana is confined entirely to Glacier National Park. All waters in the drainage are nearly pristine, and suitable for most beneficial uses with little or no treatment.

The St. Mary River and its tributaries are classified as being drinkable, after conventional treatment. Swiftcurrent Creek is seasonally dewatered and has been subject to hydrologic damage.

Map No.	Stream Segment	Drainage	Probable Impaired Use(s)	Suspected Pollutants	Pollution Sources	Reference Nos.	Severity Index	
1	Swiftcurrent Cr.	St. Mary R.	A	TSS,C	G,C	6,8	0.0	G


GLACIER
NATIONAL
PARK
Babb
St. Mary
Saint Mary River
Duck Lake
Swiftcurrent Cr.
Lake Sherburne
Lower Saint Mary L.
Saint Mary Lake
N
ST. MARY RIVER BASIN
0
5
10
Miles

6 - UPPER MISSOURI RIVER BASIN

The Upper Missouri Basin, which includes southwestern Montana and northwestern Yellowstone Park, is characterized by several large mountain ranges separated by broad agricultural valleys with extensive irrigation development. The basin is drained by the Gallatin, Madison and Jefferson rivers, which form the Missouri River near the town of Three Forks. These and other streams in the drainage are some of the most popular and productive cold-water fisheries in America.

Population in the basin is sparse and strongly tied to agriculture. However, aesthetic qualities have resulted in increased tourist trade and recreation-based industries, thus attracting new residents.

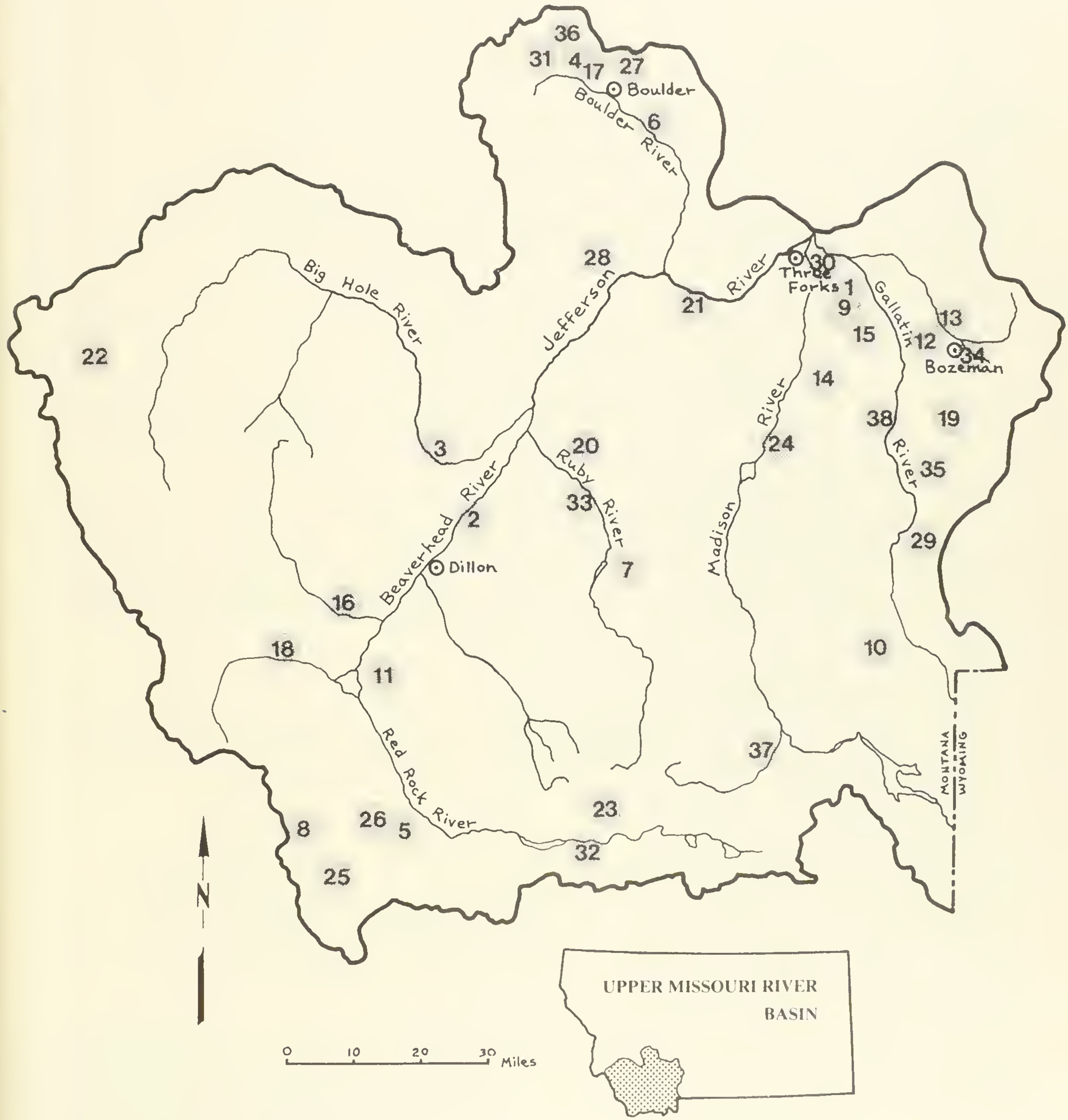
Elevations in the drainage range from over 11,000 feet in several of the mountain ranges to less than 4,500 feet at Three Forks. Valley precipitation is about 12 to 20 inches per year. Peak precipitation occurs in May and June followed by a lesser peak in September. Summers are generally warm and sunny; arctic cold-air masses sometimes settle in for several days during the winter, dropping temperatures well below zero.

Surface and groundwater quality is generally excellent, however, the basin also includes a nearly complete cross section of Montana water quality problems, such as sediment, temperature, dewatering, nutrients, coliforms, eutrophication and acid mine drainage. Quality typically degrades as water flows downstream, picking up salts, carrying higher nutrient loads and increasing in temperature. The numerous reservoirs in the basin tend to average flows and salt concentrations while causing deposition of sediment in slackwater areas and increased streambed erosion below dams.

The eight major rivers that make up the Upper Missouri River Basin include: The Red Rock, Beaverhead, Ruby, Big Hole, Jefferson, Boulder, Madison and Gallatin rivers.

Map No.	Stream Segment	Drainage	Probable Impaired Use(s)	Suspected Pollutants	Pollution Sources	Reference Nos.	Severity Index	
1	Baker Cr.	Gallatin R.	A,R	TSS,N,P	A	3		F,G
2	Beaverhead R. below Dillon	Jefferson R.	A,R	Temp,C	IA,Dillon WWTP	3,7	0.66	B,G
3	Big Hole R. below Melrose	Jefferson R.	A	Temp,TSS	IA,A	3,5		C,D,E F,G
4	Big Limber Cr.	Cataract Cr./ Boulder R.	A	TSS	G,N	2		B
5	Big Sheep Cr.	Red Rock R.	A	TSS,Temp	G,N	2,3	1.14	B,G
6	Boulder R. below Basin	Jefferson R.	A,R	Metals,TSS,TDS, N,P,Temp,C	Boulder WWTP,IM, HM,IA	1,3,7	0.61	B,G
7	Browns Gulch/ Barton Gulch	Ruby R.	A	TSS	IM	4		B
8	Cabin Cr.	Big Sheep Cr.	A	TSS,Temp	G,N	2		A,B
9	Camp Cr. below Godfrey Cr.	Gallatin R.	A,I,R	C,TSS	N,A,C	1,3,6	5.20	B,F,G
10	Cement Cr./ Taylor Fk.	Gallatin R.	A	TSS	N,G	3,6,12		A,D,F
11	Clark Canyon Cr.	Beaverhead R.	A	TSS,Temp	G,N	2	11.27	
12	Dry Cr.	E. Gallatin R.	A,R	TSS,C	A	3,6		F
13	E. Gallatin R.	Gallatin R.	A,R	NH3,DO,C,TSS, N,P	Bozeman WWTP O,U,A	1,3,6,7,8	5.49	B,F,G
14	Elk Cr.	Madison R.	R	C	A	6		F
15	Godfrey Cr.	Camp Cr.	A,L,R	C,TSS	N,A,C	1,3,6		A,B,F
16	Grasshopper Cr. below Bannack	Beaverhead R.	A,R	Metals, TSS	IM,G	1,2,3,4	2.92	B,G
17	High Ore Cr.	Boulder R.	A	Metals,TSS,pH	IM	2,3,4,5	38.18	A,B,F
18	Horse Prairie Cr.	Beaverhead R.	A	TSS	G	2		B

19	Hyalite Cr.	E. Gallatin R.	A,R	TSS,C	F,O,A	3,11		F,C
20	Indian Cr.	Ruby R.	R	C	Sheridan WWTP	3,7		B,C
21	Jefferson R.	Missouri R.	A,R	Temp,C,TSS	A,Whitehall WWTP IA,Three Forks WWTP	3,5,7	1.44	B,F,C
22	Johnson Cr.	North Fork Big Hole R.	A	TSS	F	11		B,D
23	Long Cr.	Red Rock R.	A	TSS	C	3		C
24	Madison R.	Missouri R.	A,R	Temp,As,F,C	HM,N (YNP) Ennis WWTP	1,3	0.57	A,B,C D,E,F,C
25	Meadow Cr.	Big Sheep Cr.	A	TSS,Temp	C,N	2		A,B
26	Muddy Cr.	Big Sheep Cr.	A	TSS,Temp	C,N	2,3,8		A,B
27	Nursery Cr.	Boulder R.	A	TSS,Temp	C,N,C	2		B
28	Pipestone Cr.	Jefferson R.	A	TSS	A	5		B,F
29	Portal Cr.	Gallatin R.	A	TSS	F	3		F
30	Rae Cr.	Gallatin R.	A,R	TSS,N,P	A	3		F
31	Red Rock Cr.	Boulder R.	A	TSS	F	11		B
32	Red Rock R. above Lima Reservoir	Beaverhead R.	A,R	TSS,N,P	HM,C	1,3	1.42	
33	Ruby R.	Jefferson R.	A,R	TSS	C	3,5	1.12	F,G
34	Sourdough (Bozeman) Cr.	E. Gallatin R.	A,R	TSS,C	F,O,U	3,11	0.35	F,C
35	Squaw Cr.	Gallatin R.	A	TSS,Lead	F,N	3,12		F
36	Uncle Sam Gulch/ Cataract Cr.	Boulder R.	A	Metals,TSS,pH	IM	3,4		A,B
37	W. Fork Madison R.	Madison R.	A	TSS	C	3	0.0	
38	W. Gallatin R. below Taylor Fork	Missouri R.	A	TSS,Temp	N,C,IA	3	0.0	D,F,C


UPPER MISSOURI RIVER
BASIN
Boulder
Boulder River
Big Hole River
Jefferson
River
Three Forks
Gallatin River
Bozeman
Madison River
Ruby River
Beaverhead River
Dillon
Red Rock River
MONTANA
WYOMING
N
0 10 20 30 Miles
36
31
4
17
27
6
28
30
1
9
21
13
12
34
15
22
14
38
19
3
20
24
35
33
2
29
7
16
10
18
11
37
23
8
26
5
32
25

7 - MISSOURI-SUN-SMITH RIVER BASIN

This basin includes all lands drained by a 250-mile stretch of the Missouri River in westcentral Montana from the three forks of the Missouri River to the mouth of the Marias River at Loma. Total drainage area is approximately 11,000 square miles or 7 million acres. Topography in the basin varies from mountainous to rolling plains; the lowest point in the basin is less than 3,000 feet at Loma.

The semi-arid climate of the valleys and rolling plains is typified by cold, dry winters, moist springs and warm, dry summers. Annual precipitation in these areas usually ranges from 10 to 15 inches. Mountain areas, particularly along the Continental Divide, receive significant snowfall during the winter.

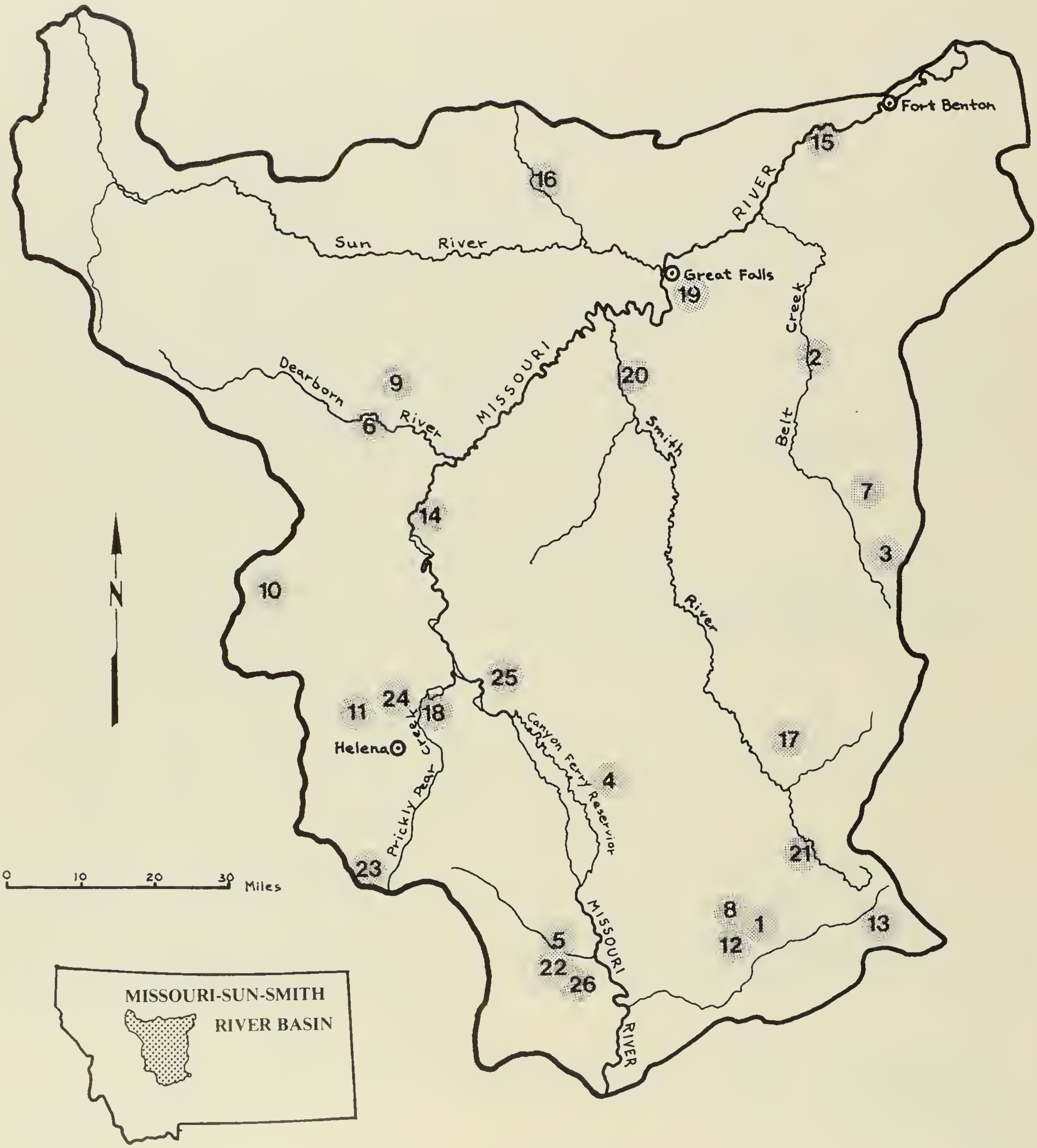
Agriculture is the leading industry in the basin and livestock production is the major agricultural operation. Irrigated lands account for 280,000 acres and dry croplands cover an additional 900,000 acres. Two-thirds of the area is in private ownership or other non-federal control and is used primarily for range or crops. Management of the federal third is largely for grazing and forest use by the U.S. Forest Service and the Bureau of Land Management.

Irrigation is the predominant consumptive use of water in the drainage, consuming an estimated 295,000 acre-feet annually. There are 17 reservoirs and run-of-river impoundments within the basin having at least 1,000 acre-feet of storage each. The three largest are Canyon Ferry and Holter, both on the Missouri River, and Gibson on the Sun River.

Water quality in the basin runs the gamut from the best to the worst in the state. There are several municipal, agricultural, and industrial discharges in the basin.

Map No.	Stream Segment	Drainage	Probable Impaired Use(s)	Suspected Pollutants	Pollution Sources	Reference Nos.	Severity Index	
1	Battle Cr.	Sixteenmile Cr.	A	TSS	A	3		
2	Belt Cr. below Dry Fk. Belt Cr.	Missouri R.	A,R	Metals,pH,TSS	A,F,IM	1,3,4,5	0.43	B,F
3	Carpenter Cr.	Belt Cr.	A,R	Metals,pH,TSS	IM,A	4,5		F
4	Confederate Cr.	Missouri R.	A	TSS	M	3		B
5	Crow Cr.	Missouri R.	A,R	N,P	A	3		G
6	Dearborn R.	Missouri R.	A	TSS	A	3	0.0	F,G
7	Dry Fk. Belt Cr.	Belt Cr.	A,R	Metals,pH,TSS	IM	1,3,4		A,B
8	Faulkner Cr.	Battle Cr.	A	TSS	A	3		
9	Flat Cr.	Dearborn R.	A	TSS	A	3		A
10	Fool Hen Cr./ Virginia Cr.	Canyon Cr./ Little Prickly Pear Cr.	A,R	TSS,pH	IM	4	0.0	A
11	Granite Cr.	Sevenmile Cr./ Tenmile Cr.	A	TSS	G,N	2		B
12	Hay Cr.	Battle Cr.	A	TSS	A	3		
13	Middle Fork Sixteenmile Cr.	Missouri R.	A	TSS	A	3		
14	Missouri R. from headwaters to Great Falls	Missouri R.	P	As,F	N(YNP)	3		A,C,G
15	Missouri R. from Great Falls to Fort Peck Lake	Missouri R.	A,I,L, P,R	C,TSS,TDS,P Metals	O,N,A,WWTPs, IM,G,HM	2,8	7.12	A,C,D,G
16	Muddy Cr.	Sun R.	A,I,P,R	TSS,N	IA,N,HM	1,3,4,5,6,8	81.24	A,B,C D,F,G

17	Newland Cr.	Smith R.	A	TSS	A,HM,F	3,4		G
18	Prickly Pear Cr. below E. Helena	Missouri R.	A,I,L, P,R	Metals,NH3,C, TSS,N,P	Helena WWTP,I E. Helena WWTP M,IM,U,IA,G,HM	1,2,3,5,6,7 8,11	20.0	A,B,C D,F,G
19	Sand Coulee Cr.	Missouri R.	A,R	Metals,pH,TSS	IM	1,3,4		B,F
20	Smith R. below Hound Cr.	Missouri R.	A,R	TSS	N,A,F	3,4,5	2.87	A,D,G
21	S.Fork Smith R.	Missouri R.	A	TSS,Temp	A	3		
22	Spring Branch Cr.	Warm Springs Cr.	A,R	TSS,N,P	A	3		
23	Spring Cr.	Prickly Pear Cr.	A,I,L,R	Metals,TSS pH,TDS	IM	1,2,3,6	18.22	A,B,C D,F
24	Tenmile Cr.	Prickly Pear Cr.	A,P	Metals	IM	3,11	0.45	G
25	Trout Cr.	Missouri R.	A,R	C	O	3	0.33	
26	Warm Springs Cr.	Missouri R.	A,R	TSS,N,P	A	3		


Fort Benton
15
16
RIVER
Sun
River
Great Falls
19
Creek
2
Belt
Dearborn
River
9
6
MISSOURI
20
Smith
7
3
14
10
N
River
25
24
11
18
Creek
Helena
17
Canyon Ferry Reservoir
4
Prickly Pear
21
23
0 10 20 30 Miles
8
1
12
13
5
22
26
MISSOURI
RIVER
MISSOURI-SUN-SMITH
RIVER BASIN

8 - MARIAS RIVER BASIN

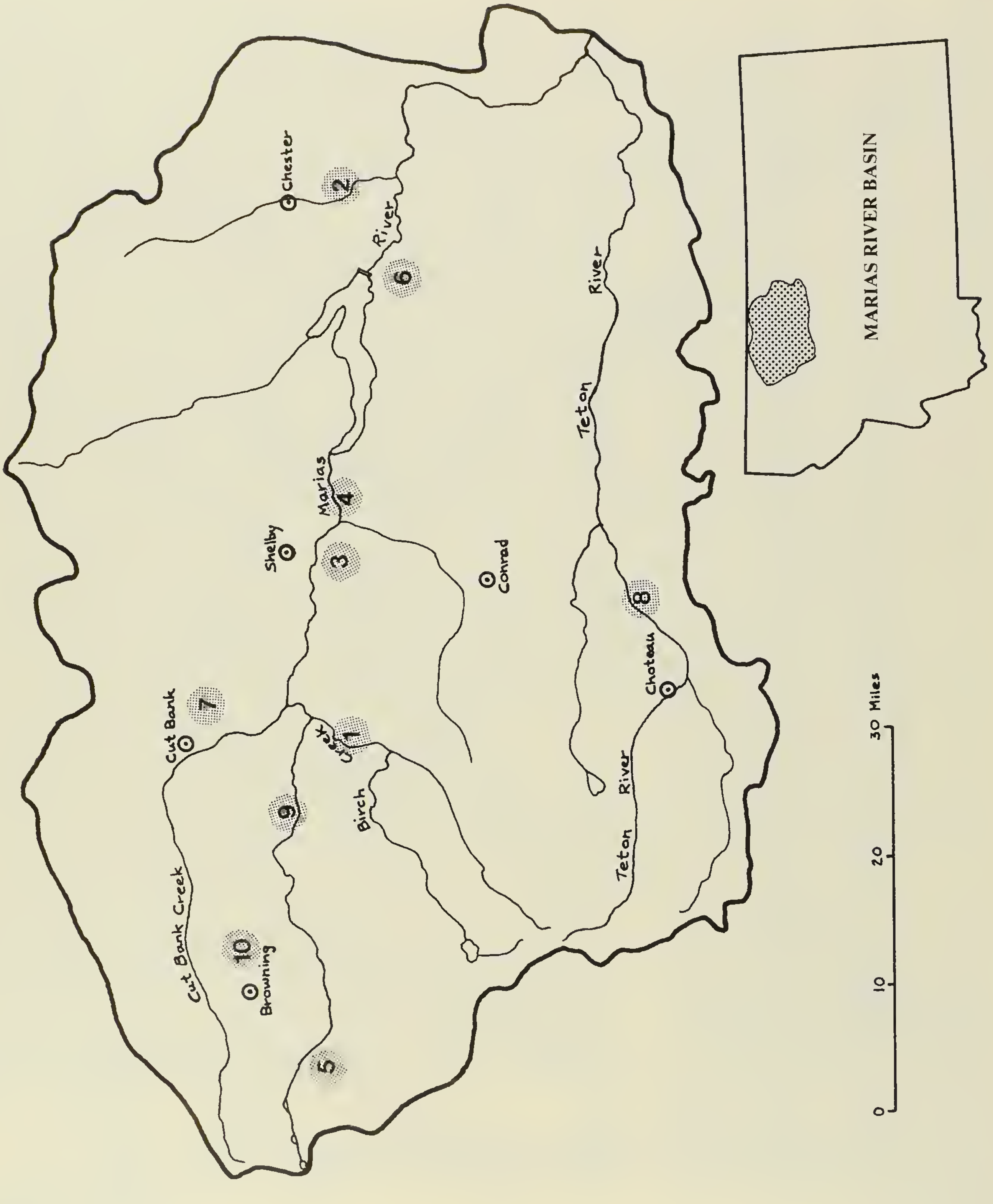
The headwaters of the Marias River are along the east slope of Glacier Park. From the Continental Divide the river flows through the mountains and rolling agricultural country in northcentral Montana to the Missouri River below Fort Benton. The basin drains approximately 9,100 square miles.

The Marias basin is characterized by hot, dry summers and cold, dry winters. A large portion of the annual precipitation occurs in the spring. Precipitation ranges from 10 to over 30 inches per year, the latter falling in the mountains. Mean monthly temperatures range from -2 degrees F in January to 83 degrees F in July. Wind is a persistent feature of the basin's climate; frequent warm, dry chinook winds may cause rapid snowmelt and flooding.

About 62 percent of basin lands are used for pasture and range. Croplands comprise 31 percent of the total area; 2 percent is under irrigation and 29 percent is dryland. Irrigated agriculture is the largest water user in the basin, annually diverting approximately 780,500 acre-feet. The major irrigated crop is hay. Forest and woodlands occupy the remaining 7 percent of the basin. Oil and gas production occurs throughout the basin. The urban population is small; only about 15,000 people live in the nine largest communities.

The principal rivers are the Marias and the Teton. Water quality is good to excellent in the western headwaters region, but degrades as the rivers flow from west to east. The predominant pollutants are sediment and salt.

Map No.	Stream Segment	Drainage	Probable Impaired Use(s)	Suspected Pollutants	Pollution Sources	Reference Nos.	Severity Index	
1	Birch Cr.	Marias R.	A,I,R	TSS,TDS	IA	1,3,5,6	1.41	F,G
2	Cottonwood Cr./ Marias R.	Marias R.	A,R	TSS,Temp	IA	3		A,G
3	Hilger Coulee	Marias R.	A,I	TDS	A	3		
4	Marias R. above Cottonwood Cr.	Missouri R.	A	TSS	A	3	0.11	G
5	Midvale Cr. below E. Glacier	Two Medicine R.	R	C	E. Glacier WWTP O	3,6,7		B
6	Pondera Cr.	Marias R.	A,I,P,R	N,P,TDS,TSS	A,N	8	44.00	
7	Spring Coulee	Marias R.	A,I,R	Phenols, TDS	P	3	3.71	B
8	Teton R. below Priest Butte Lakes	Marias R.	A,I,R	TDS,Temp,TSS	IA,HM	3	8.45	A,B,F,G
9	Two Medicine R.	Marias R.	A,R	TSS	IA	3	0.0	G
10	Willow Cr.	Cut Bank Cr.	A,R	N,P,NH3	Browning WWTP	6,7	1.04	B


MARIAS RIVER BASIN
Chester
Marias
River
Shelby
Conrad
Cut Bank
Cut Bank Creek
Browning
Birch
Teton
River
Teton
River
Choteau
1
2
3
4
5
6
7
8
9
10
0
10
20
30 Miles
N

9 - MIDDLE MISSOURI RIVER BASIN

The Middle Missouri River Basin has as its axis the 275 miles of the Missouri River that flows from Fort Benton to the Fort Peck Dam.

The upper third of the basin is rolling, relatively roadless prairie, broken by the spectacular and rugged white cliffs of the Missouri River Breaks, with the Bear Paw Mountains looming to the north. The middle stretch flows under the Fred Robinson Bridge, the only bridge between Fort Benton and Fort Peck Dam, east through the Charles M. Russell Wildlife Refuge where cattle and wildlife graze on rough, prairie land. The lower third of the basin encompasses the sprawling Fort Peck Reservoir, which is surrounded by the refuge and "badlands."

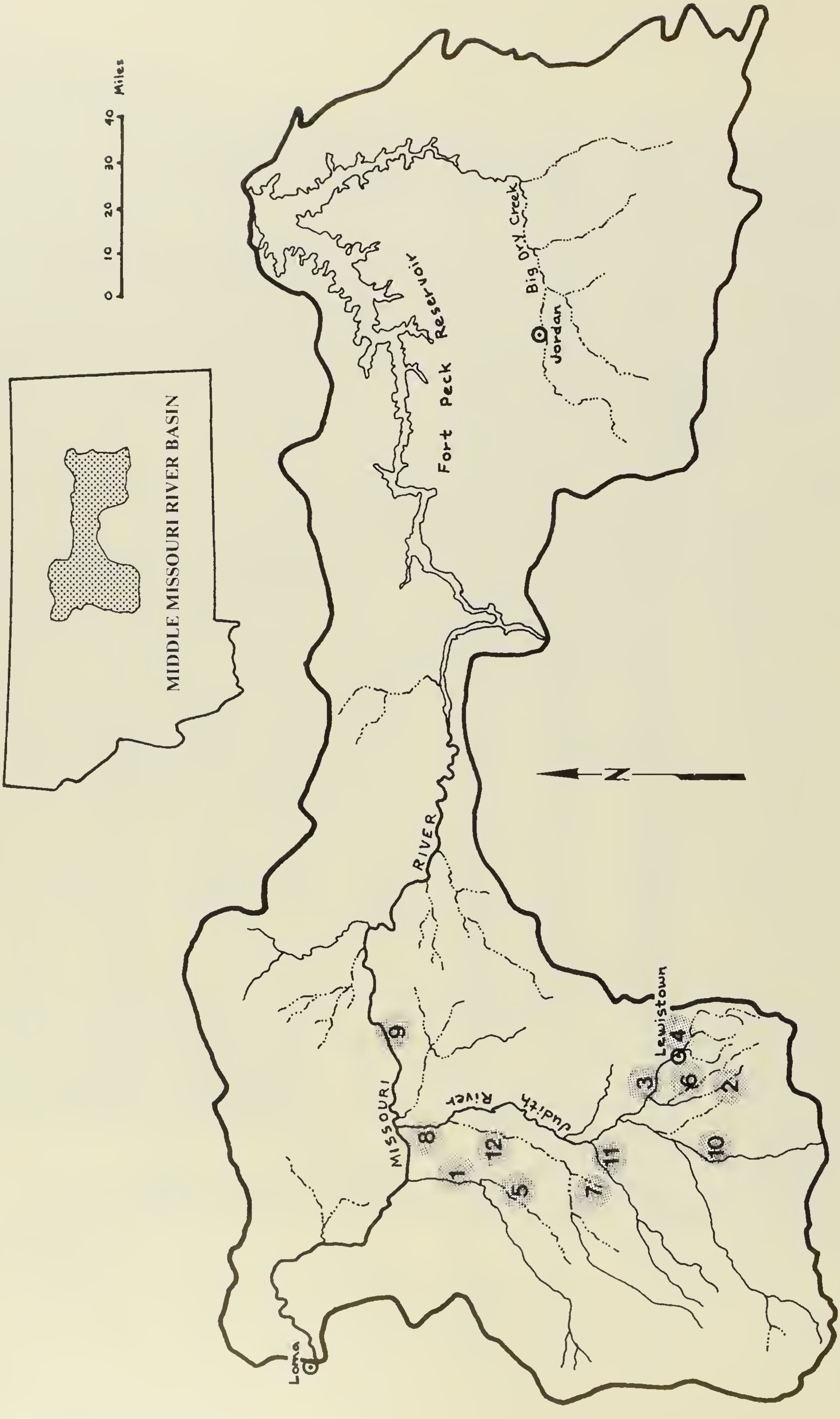
The basin is typified by low annual rainfall and temperature extremes. Annual precipitation averages between 11 and 15 inches, with June the wettest month. Snowmelt from the minor mountain ranges that dot the area add to flows between April and June.

The only major population center is Lewistown, with fewer than 10,000 residents. The western part of the basin has a greater percentage of grain-growing land, while the east has more rangeland, which is the largest land use in the basin. The largest water use in the basin is for irrigation, diverting approximately a quarter-million acre-feet annually.

The basin has substantial energy resources in the form of petroleum and coal. There is continuing petroleum exploration and production, but it has had little impact on water quality. There are large deposits of strippable coal in the southern and eastern portions of the basin. These have yet to be developed, but could result in coal mining and synthetic fuel production.

The basin contains only a few municipal and two industrial dischargers and several feedlots. However, natural sediment and salts, amplified by agricultural practices, are the dominant spoilers of the basin's water quality. These pollutants emanate from irrigation returns, poor soil conservation practices, saline seep, overgrazing and natural erosion.

Map No.	Stream Segment	Drainage	Probable Impaired Use(s)	Suspected Pollutants	Pollution Sources	Reference Nos.	Severity Index	
1	Arrow Creek	Missouri R.	A,I	TDS,TSS	N,A	3,10		A,D,G
2	Beaver Cr.	Big Spring Cr.	A,R	N,P	A	3		
3	Big Spring Cr.	Judith R.	A,R	N,P,NH3	Lewistown WWTP	7	0.89	B,D
4	Boyd Cr.	Big Spring Cr.	R	C	O,A	3		
5	Coffee Cr.	Arrow Cr.	A,I,R	TDS,TSS	N,A	3	31.92	
6	Cottonwood Cr.	Beaver Cr.	A,R	N,P	A	3		
7	Dry Wolf Cr.	Wolf Cr.	A,I,L,R	TDS,TSS	N,A	3	43.69	
8	Judith R.	Missouri R.	A,R,I	TDS,N,P,C,TSS	A,O,N	3	2.98	A,C,D,G
9	Missouri R. from Great Falls to Fort Peck Lake	Missouri R.		See Missouri-Sun-Smith Basin				
10	Ross Fork Cr.	Judith R.	A,R	BOD,N,P	A	3		
11	Sage Cr. from Danvers to mouth	Judith R.	A,I	TDS	N,A	3		
12	Wolf Cr. from Denton to mouth	Judith R.	A,I,R	TDS,TSS	N,A	3,8	0.82	G



MIDDLE MISSOURI RIVER BASIN
0 10 20 30 40 Miles
Fort Peck Reservoir
Big Dry Creek
Jordan
N
RIVER
MISSOURI
Judith River
Lewistown
Loma
1
2
3
4
5
6
7
8
9
10
11
12

10 - MUSSELSHELL RIVER BASIN

The Musselshell River originates at the confluence of its north and south forks east of Martinsdale. From its origin in the Little Belt Mountains, the river flows in an easterly direction for 125 miles along the southern flank of the Big Snowy Mountains. The river then heads north for 55 miles to Fort Peck Reservoir. The Musselshell and its tributaries drain an area of approximately 8,000 square miles.

The basin terrain generally may be described as hilly. Soils in thc basin are as varied as the physiographic features. The valley of the Musselshell, which contains the basin's more desirable farmland, is less than a mile wide and is bordered by sandstone rimrocks and rugged shaly breaks along most of its course.

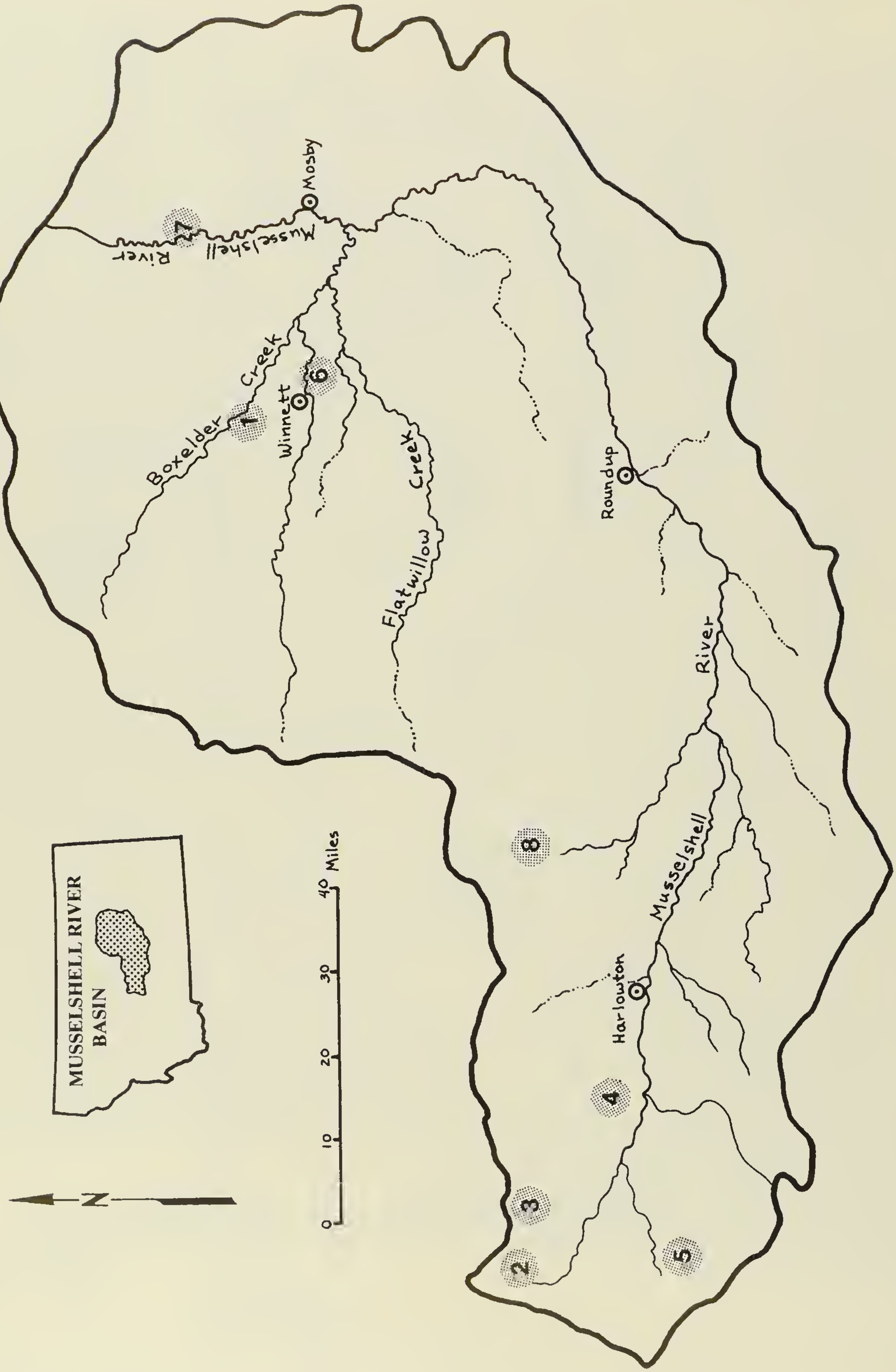
The Fort Union coal formation is present in the central portion of the basin near Roundup. The formation contains commercial coal beds under development southeast of Roundup.

The Musselshell Basin is best described as a semi-arid region with a short growing season. Average annual precipitation is around 12.5 inches. Forty to fifty percent falls in the spring, with June the wettest month. The various mountain ranges contribute some snowmelt runoff.

The basin is rural. The largest land use is privately owned rangeland, comprising 67 percent of the basin. Irrigation is the basin's largest water consumer, diverting nearly one-half million acre-feet annually.

Water quality problems in the basin are predominately natural; some are aggravated by logging and agriculture. Some saline seep occurs. The quality of Musselshell water becomes more and more degraded, due to sediment and salts, as it travels toward the Fort Peck Reservoir.

Map No.	Stream Segment	Drainage	Probable Impaired Use(s)	Suspected Pollutants	Pollution Sources	Reference Nos.	Severity Index	
1	Box Elder Cr.	Musselshell R.	A,I,R	TSS	N,A	8	2.65	
2	E. Mill Cr.	N. Fork Musselshell R.	A	TSS	F	11		B
3	Fawn Cr./ Daisy Dean Cr.	Musselshell R.	A	TSS	F	11		B
4	Haymaker Cr.	Musselshell R.	A	TSS	F	11		B
5	Little Cottonwood Cr.	S. Fork Musselshell R.	A	TSS	F	11		B
6	McDonald Cr.	Box Elder Cr.	A,R	N,P,NH3,TSS	Winnett WWTP,A	5,7	0.0	B,F
7	Musselshell R.	Missouri R.	A,I,L,R	TDS,TSS,N,P,Temp	A,N,HM	3,5,8,10	7.58	F,C
8	Timber Cr.	Careless Cr.	A	TSS	F	11		B


MUSSELSHELL RIVER BASIN
Musselshell River
Mosby
Boxelder Creek
Winnett
Flatwillow Creek
Roundup
Musselshell River
Harlowton
1
2
3
4
5
6
7
8
0
10
20
30
40 Miles
N

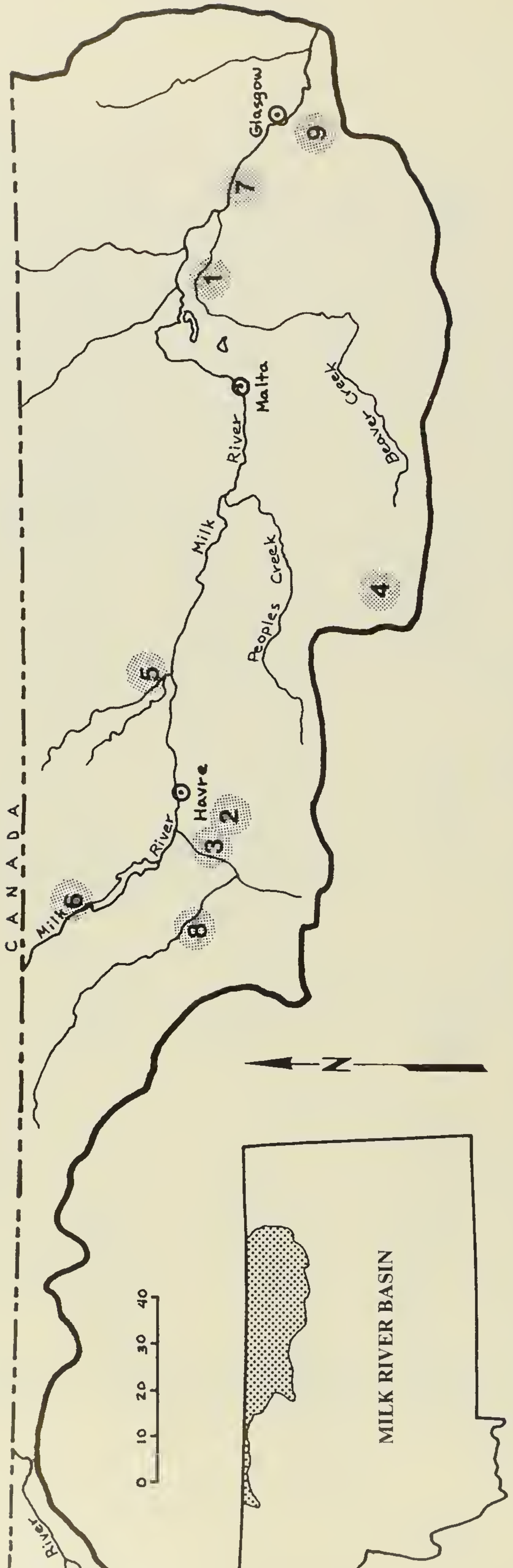
11 - MILK RIVER BASIN

The Milk River originates in Glacier National Park, flows into Canada, then re-enters the U.S. and heads east to its confluence with the Missouri River below Fort Peck Dam. The basin drains about 15,000 square miles. The major geologic event that influenced soils of the Milk River Basin was continental glaciation, which resulted in the filling of many stream valleys with alluvium.

The largest land use in the basin is privately owned rangeland, constituting about 45 percent of the total land area. The next largest is federal forest and rangeland, which accounts for about 28 percent. Cropland takes up about 23 percent, mostly in dryland grain production in the western half of the basin. Irrigation is the largest water user, diverting about 1.5 million acre-feet annually.

There are several industrial and agriculture waste discharges and at least a dozen municipal waste discharges. Sediment and salts are the major despoilers of basin waters. The sources include poor grazing and cropping practices, irrigation returns and saline seeps.

Map No.	Stream Segment	Drainage	Probable Impaired Use(s)	Suspected Pollutants	Pollution Sources	Reference Nos.	Severity Index	
1	Beaver Cr. below Lake Bowdoin	Milk R.	A,I,R	TDS	HM,N	9	5.55	B,F
2	Beaver Cr. south of Havre	Milk R.	A,R	Temp,TSS,C	G,HM	1		B,C,D F,G
3	Big Sandy Cr.	Milk R.	A,I,R	TSS	A,N	3,8	11.73	G
4	Little Peoples Cr.	Peoples Cr.	A,L,R	TSS,Metals,pH	M,G	1,2,4	0.86	B,D
5	Lodge Cr.	Milk R.	A,R	DO	unknown (N?)	3	0.22	
6	Milk R. from Canada to Fresno Res.	Milk R.	A,P,R	TSS,C	A,N	3		E
7	Milk R. below Fresno Dam	Milk R.	A,I,P,R	TSS	N,A	8	5.05	A,C,D,G
8	Sage Cr.	Milk R.	A,I,L,R	TSS,TDS	DA	3	3.58	B
9	Willow Cr.	Milk R.	A,I	TSS	HM,N,A	2		


CANADA
Glasgow
Malta
Havre
Milk River
Milk River
Milk River
Peoples Creek
Beaver Creek
1
2
3
4
5
6
7
8
9
N
0 10 20 30 40
MILK RIVER BASIN

12 - LOWER MISSOURI RIVER BASIN

The Lower Missouri River runs from below Fort Peck Dam to the Montana-North Dakota boundary. The basin has a total area of about 10,000 square miles with elevations ranging from 3,500 feet in the Big Sheep Mountains to 1,900 feet at the North Dakota border. Topography varies between rolling hills and flat plains that are occasionally cut by stream valleys, sometimes forming badlands-type pinnacles, bluffs and steep banks.

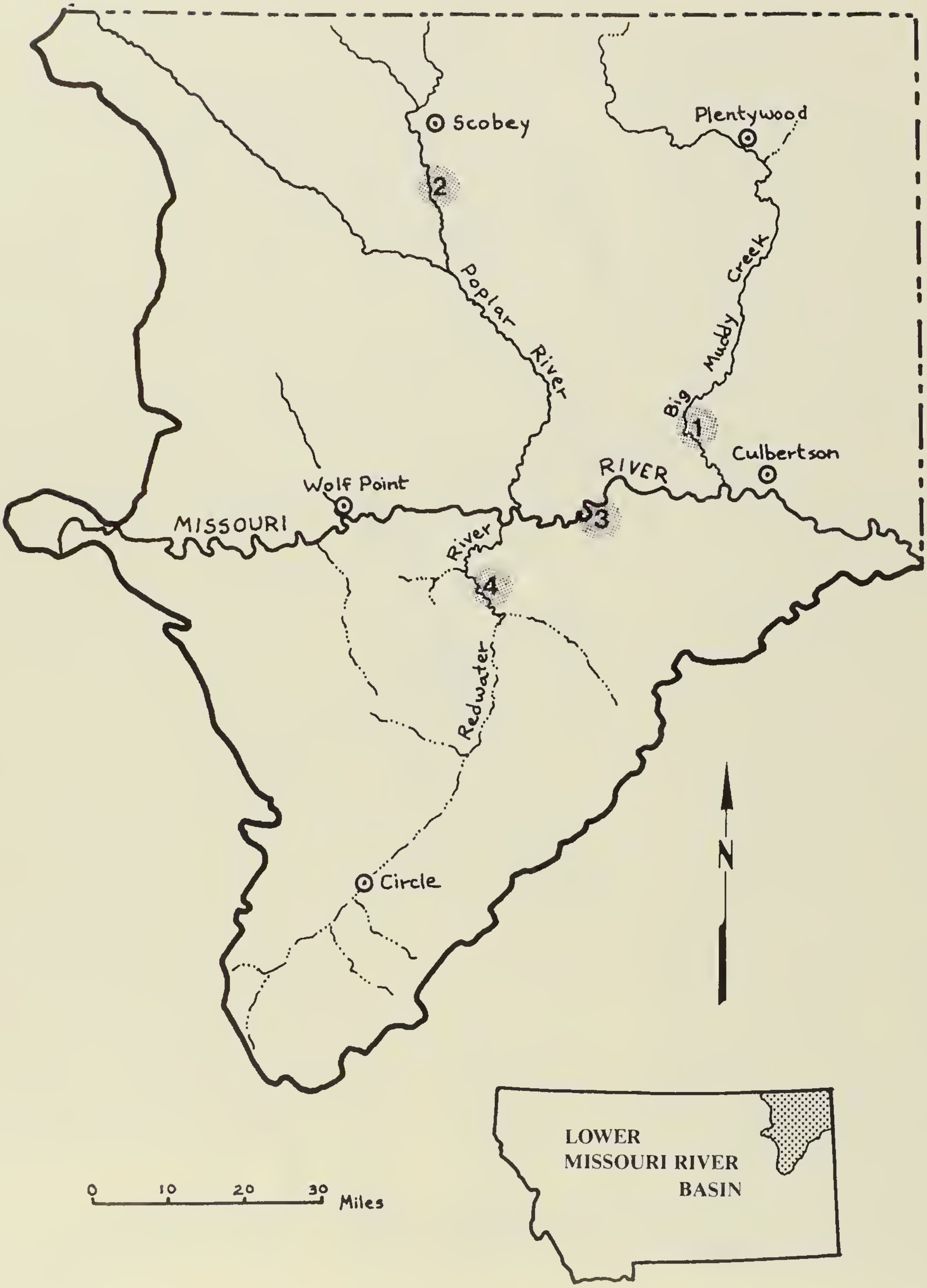
A continental type climate is typical for the basin. Winters are cold, summers are warm and springs are wet. Precipitation varies from 10 to 14 inches in the western portion to about 17 inches annually in the east.

The largest land use in the basin is privately owned rangeland, which constitutes about 40 percent of the total land area. The next largest is cropland at about 33 percent. Federal rangeland makes up about 19 percent of the land area.

The largest town is Wolf Point, with about 3,000 residents. There remains a vast amount of strippable coal under the southern part of the basin. Oil and gas development in the Williston Basin have recently stimulated growth in the area. The largest water use in the Lower Missouri Basin is irrigation, diverting about 270,000 acre-feet annually.

Natural waters of the basin generally are of only fair quality, being high in sodium and sulfates and providing warm-water habitats for aquatic life.

Map No.	Stream Segment	Drainage	Probable Impaired Use(s)	Suspected Pollutants	Pollution Sources	Reference Nos.	Severity Index	
1	Big Muddy Cr. below Reserve	Missouri R.	A,I,R	TDS,C	A,N	3,8	5.46	G
2	E. Fork Poplar R./ Poplar R.	Missouri R.	A,I,L,R	B,TDS,Cl N,P,DO,pH	HM,P,N	1,3,10	4.26	A,E,F,G
3	Missouri R. below Milk R.	Missouri R.	A,P,R	TSS,TDS,P,Metals	N,A	8	1.99	C,D,E
4	Redwater R. from Circle to mouth	Missouri R.	A,I,L,R	TDS	N,A	3,8	7.37	


Scobey
Plentywood
2
Big Muddy Creek
Poplar River
1
Culbertson
RIVER
Wolf Point
MISSOURI
3
River
4
Redwater
N
Circle
0 10 20 30 Miles
LOWER
MISSOURI RIVER
BASIN

13 - UPPER YELLOWSTONE RIVER BASIN

The Upper Yellowstone River Basin in southcentral Montana encompasses the eastern slopes of the Rocky Mountains and the western edge of the Great Plains. Elevations descend from 12,799 feet (Granite Peak--the highest point in Montana) down to 3,300 feet.

The Montana portion of the basin is drained by the Yellowstone River and all of its tributaries from the state line in Yellowstone National Park to below the mouth of the Clark's Fork.

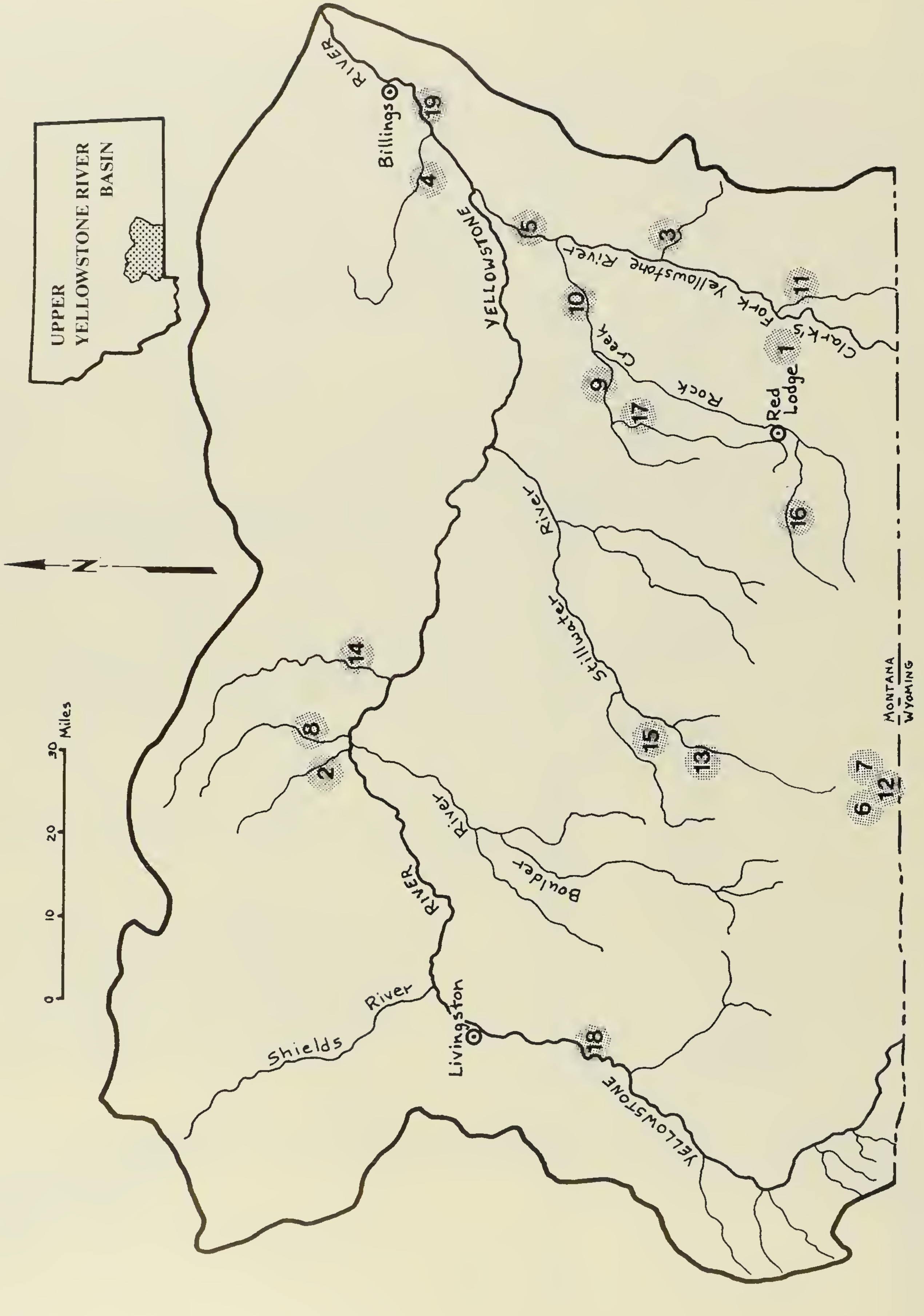
The Clark's Fork River Valley near Belfry is the driest part of the basin and one of the driest in Montana. The average annual precipitation there is only about six inches. Precipitation in the mountains is up to 35 inches per year.

More than 100,000 people live in the basin, most of them in Billings. This is the largest urban and industrial center in Montana. The Billings area has three petroleum refineries, two major municipal wastewater discharges, a sugar beet refinery and a power plant with a heated discharge. However, agriculture is still the area's predominant economic activity. The largest water user is irrigation, depleting almost 800,000 acre-feet per year.

About 30 percent of the basin is forest land. Much of the basin offers recreational opportunities, including 95 miles of "blue ribbon" trout fishing on the Yellowstone River from Yellowstone Park to near the town of Big Timber.

Except for acid-mine drainage in certain tributaries. water quality in headwater streams near Yellowstone Park is excellent. The mainstem and larger tributaries pick up dissolved solids and suspended sediment as they proceed downstream. They also become warmer. The Clark's Fork of the Yellowstone is unique among the major tributaries in that it has only fair to poor water quality due to high turbidity and sediment loads. The segment of the Yellowstone near the mouth of Clark's Fork is a transition zone between cold and warm-water aquatic life.

Map No.	Stream Segment	Drainage	Probable Impaired Use(s)	Suspected Pollutants	Pollution Sources	Reference Nos.	Severity Index	
1	Bear Cr.	Clark's Fork R.	A,R	C,N,P,TDS,TSS	O,N,A,IM	10		G
2	Big Timber Cr.	Yellowstone R.	A	TSS	IA	10		G
3	Bluewater Cr.	Clark's Fork R.	A,I,R	TSS,N,P	IA,HM,N	1,2,5,10	0.56	B,F,G
4	Canyon Cr.	Yellowstone R.	A	TSS,N,P	IA	10		B,F
5	Clark's Fork R.	Yellowstone R.	A,R	TSS,Temp,TDS	N,A,IA	8,10	2.40	A,G
6	Daisy Cr.	Stillwater R.	A,R	Metals,pH,TSS	IM	3,4,10		A,B
7	Fisher Cr.	Clark's Fork R.	A,R,	Metals,pH	IM	4,12		
8	Otter Cr.	Yellowstone R.	A	TSS	IA	10		
9	Red Lodge Cr.	Rock Cr.	A	TDS,TSS	IA	10		G
10	Rock Cr.	Clark's Fork R.	A,R	C,N,P	Joliet WWTP,A Red Lodge WWTP	5,7,10	0.0	B,F,G
11	Silver Tip Cr.	Clark's Fork R.	A,R,I	TSS,Oil,TDS	P,N	10		
12	Soda Butte Cr.	Lamar R.	A	Metals,pH	IM	1,12		B,D,E
13	Stillwater R. below Daisy Cr.	Yellowstone R.	A,R	Metals,pH,TSS	IM	3,4,10	0.0	B,G
14	Sweet Grass Cr.	Yellowstone R.	A	TSS	IA	10		G
15	Verdigris Cr.	Stillwater R.	A	TSS	IM	10		
16	W. Fork Rock Cr.	Rock Cr.	P	Giardia	N	10		C,F
17	Willow Cr.	Red Lodge Cr.	A	TDS,TSS	IA	10		G
18	Yellowstone R. from Gardiner to Livingston	Yellowstone R.	A,P,R	As,F,P	N	3	1.45	A,E
19	Yellowstone R. from Laurel to Custer	Yellowstone R.	A,P,R	Phenols,Temp,C N,P,NH3,BOD TSS	Laurel WWTP Billings WWTP I,O,U, Yegen Drain,IA	3,7,10	0.98	B,C


UPPER YELLOWSTONE RIVER BASIN
N
0
10
20
30
Miles
Billings
Red Lodge
Livingston
YELLOWSTONE RIVER
RIVER
Clark's Fork Yellowstone River
Rock Creek
Stillwater River
Boulder River
Shields River
YELLOWSTONE
MONTANA
WYOMING
1
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14 - MIDDLE YELLOWSTONE RIVER BASIN

The Middle Yellowstone Basin is on the western edge of the Great Plains. It includes the Yellowstone River and all of its tributaries from the confluence of Pryor Creek at Huntley to the confluence of the Tongue River at Miles City.

The basin is generally an area of rolling hills with gentle to moderate relief. The Bighorn Mountains spread into the southwest portion of the basin, giving that area a mountainous character. The basin drains 10,600 square miles.

Some of the soils in the basin are poorly drained and have a high salt content. The mountains bordering the basin create a moisture shadow. Sufficient snow falls in the mountains to give distinct runoff periods in the spring. Average annual precipitation for the basin is 11 to 16 inches, mostly falling in late spring and early summer.

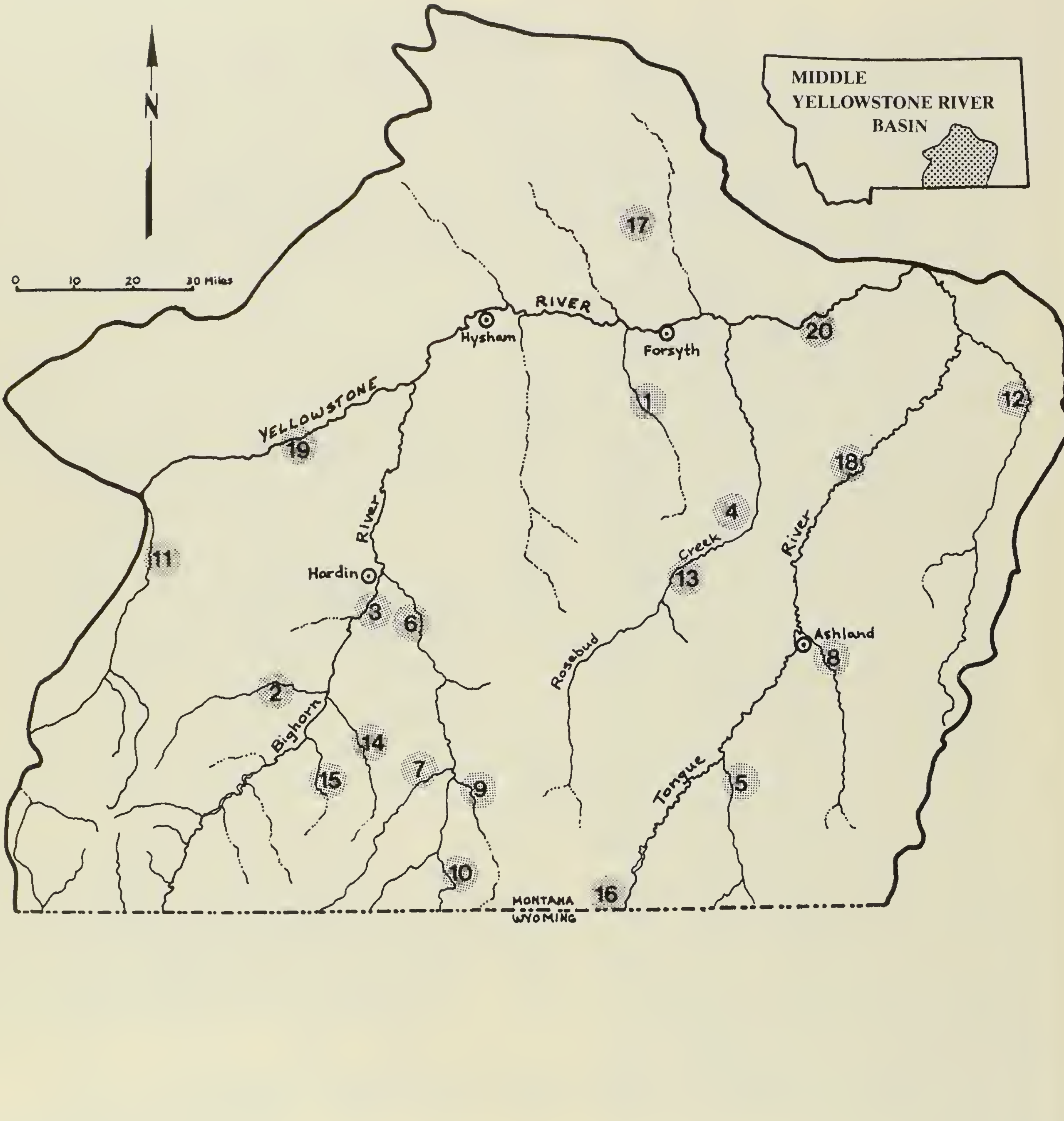
About 75 percent of the basin's land is used for pasture and range. Forests occupy about 7 percent.

More than 90 percent of Montana's coal production occurs in this basin. Underlying the basin is the Fort Union Formation, which contains a large percentage of the strippable coal in the United States.

Irrigated agriculture is the primary water user, depleting more than one-half million acre-feet per year. Industrial use has been negligible, but increasing and largely speculative demands for water have been made by energy concerns for power plants, coal-conversion facilities and coal-slurry pipelines. Increased coal and energy production would also bring about a large increase in population.

Water quality generally declines from southwest to northeast through the basin as streams warm and pick up dissolved and suspended materials. Quality is best in the headwaters of the larger tributaries on the south side of the Yellowstone and worst in smaller tributaries heading closer to the mainstem. Most streams support warm-water fisheries except portions of the Bighorn, Rosebud Creek and Tongue River drainages.

Map No.	Stream Segment	Drainage	Probable Impaired Use(s)	Suspected Pollutants	Pollution Sources	Reference Nos.	Severity Index	
1	Armell's Cr.	Yellowstone R.	A,I,L,R	TDS	N,I	8,10	13.24	F
2	Beavais Cr.	Pass Cr.	A,I,L,R	TSS,TDS	N,A	3,10	11.67	
3	Bighorn R. below St. Xavier	Yellowstone R.	A,P,R	TSS	N,A	3	3.75	
4	Cow Cr.	Rosebud Cr.	A,I,	TDS	N,I	10		F
5	Hanging Woman Cr.	Tongue R.	A,I,L,R	TSS,TDS	N,A	3,10	8.37	
6	Little Bighorn R.	Bighorn R.	A,R	TSS,TDS	N,A	1,5,10	9.96	F
7	Lodge Grass Cr.	Little Bighorn R.	A	TDS,TSS	N,A	10		
8	Otter Cr.	Tongue R.	A,I,L,R	TSS,TDS	N,A	3,10	7.34	
9	Owl Cr.	Little Bighorn R.	A,I	TSS,TDS	N,A	3,10		
10	Pass Cr.	Little Bighorn R.	A,I	TSS,TDS	N,A	3,5,10		F
11	Pryor Cr.	Yellowstone R.	A,I,R	TSS,TDS,Temp	N,A	3,10	1.17	G
12	Pumpkin Cr.	Tongue R.	A,I,L,R	TSS,TDS	N,A	3	10.53	
13	Rosebud Cr. below Colstrip	Yellowstone R.	A,I,L,R	TSS,TDS,Temp	N,A	1,3,8,10	10.85	
14	Rotten Grass Cr.	Bighorn R.	A,I	TSS,TDS	N,A	3,10		
15	Soap Cr.	Bighorn R.	A,I	TSS,TDS	N,A	3,10		
16	Squirrel Cr.	Tongue R.	A,I	TDS	N,A	10		
17	Stellar Cr.	Little Porcupine Cr.	A	TSS	HM,N	2		B
18	Tongue R.	Yellowstone R.	A,I,L,R	TSS	N,A	8	4.28	F,G
19	Yellowstone R. from Laurel to Custer	Yellowstone R.		See Upper Yellowstone Basin				
20	Yellowstone R. below Custer	Yellowstone R.	A,I,L,P,R	TSS,TDS,N,P	N,A	10	7.02	C,D,E,G


MIDDLE
YELLOWSTONE RIVER
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YELLOWSTONE
RIVER
Hysham
Forsyth
Hardin
Ashland
River
Bighorn
Rosebud
Creek
Tongue
River
MONTANA
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15 - LOWER YELLOWSTONE RIVER BASIN

The Lower Yellowstone River Basin includes the Yellowstone River and all of its tributaries from Miles City (excluding the Tongue River) to the North Dakota border. With the exception of the Powder and Yellowstone rivers, most streams in this basin are small and many have intermittent flows. The basin drains about 11,650 square miles, an area of sparsely forested rolling hills and prairie grasslands.

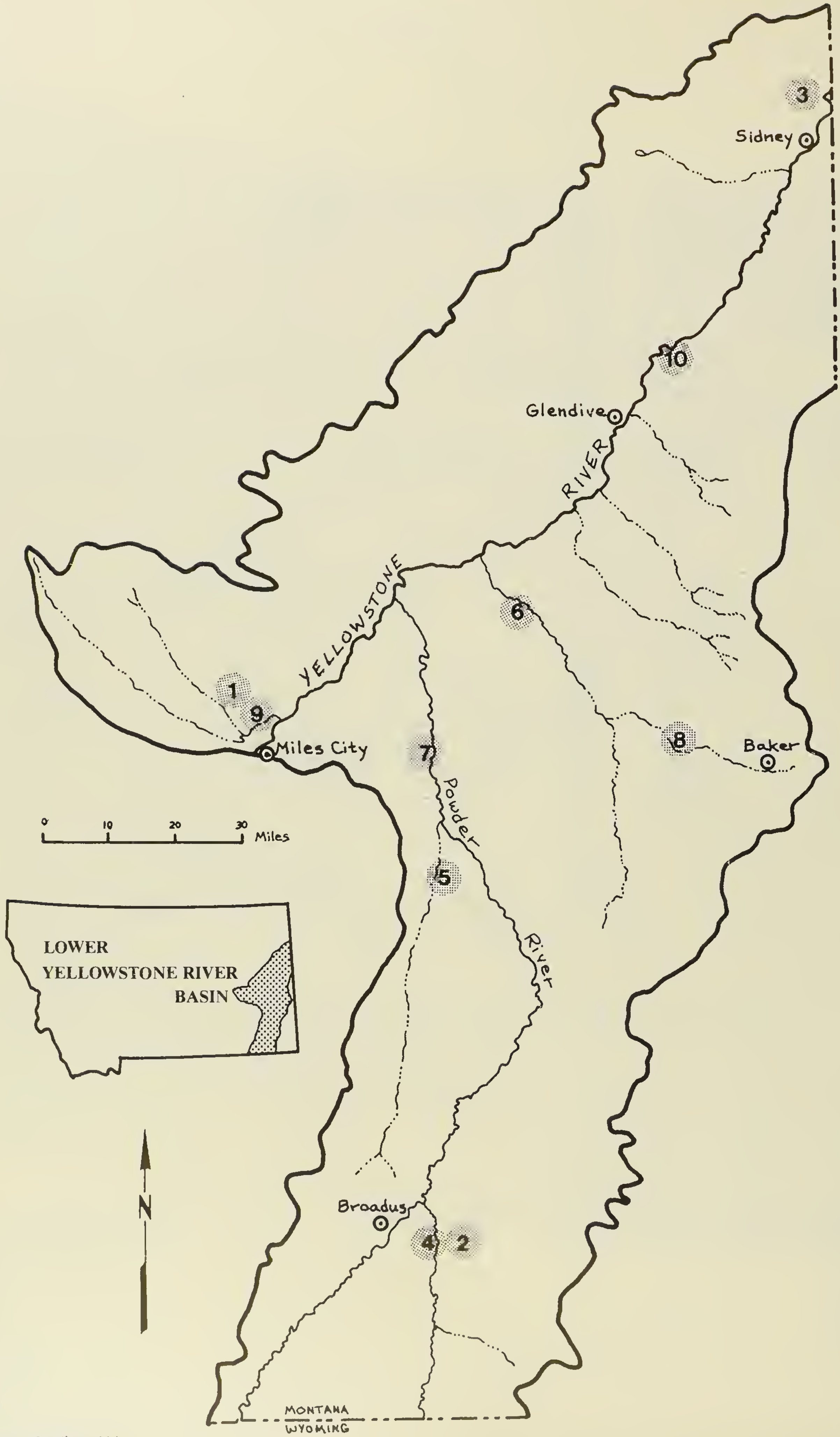
Elevations in the basin range from 2,000 to 5,000 feet. The basin's climate is typical of the semi-arid Northern Great Plains, with dry, cold winters, warm summers, variable rainfall and low humidity. June is usually the wettest month and average annual precipitation ranges between 12 and 14 inches.

Sixty-two percent of the basin is rangeland and used for livestock grazing. Cropland takes up only 15 percent of the basin and only 12 percent of that is irrigated, mostly along the Yellowstone River. The basin is largely rural.

The primary water use is for irrigation to produce hay. At least 750,000 acre-feet of water a year is diverted, with about 185,000 acre-feet consumed or depleted. Water use will increase as coal reserves are developed. The Fort Union Formation lies under part of the basin.

With the exception of the Yellowstone River and one or two others, streams in the basin have naturally poor quality water because of high sediment loads and large concentrations of salts. One stream, the Powder River, had been described as "a mile wide and an inch deep, too thick to drink and too thin to plow." Most streams in the basin support warm-water aquatic life.

Map No.	Stream Segment	Drainage	Probable Impaired Use(s)	Suspected Pollutants	Pollution Sources	Reference Nos.	Severity Index	
1	Deadman Cr.	Sunday Cr.	A	TSS	G,N	2		B
2	E. Fork Little Powder R.	Little Powder R.	A,I	TSS,TDS	N,A	3	1.50	
3	First Hay Cr.	Yellowstone R.	A	TDS,CL	P	10		
4	Little Powder R.	Powder R.	A,I	TSS,TDS	N,A	3	5.12	G
5	Mizpah Cr.	Powder R.	A,I,L,R	TSS,TDS	N,DA	3,5,10	13.38	F
6	O'Fallon Cr.	Yellowstone R.	A,I,R	TSS,TDS	N,A	3,10	3.79	
7	Powder R.	Yellowstone R.	A,I,L,R	TSS,TDS	N,A	3,5,8,10	25.54	A,D,F,G
8	Sandstone Cr.	O'Fallon Cr.	A,R	C,N,P	Baker WWTP	10		
9	Sunday Cr.	Yellowstone R.	A,I	TSS,TDS	N,A	3	6.54	
10	Yellowstone R. below Custer	Yellowstone R.		See Middle Yellowstone Basin				



3
Sidney
10
Glendive
RIVER
YELLOWSTONE
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9
Miles City
7
8
Baker
Powder
River
0 10 20 30 Miles
5
LOWER
YELLOWSTONE RIVER
BASIN
N
Broadus
4
2
MONTANA
WYOMING

16 - LITTLE MISSOURI RIVER BASIN

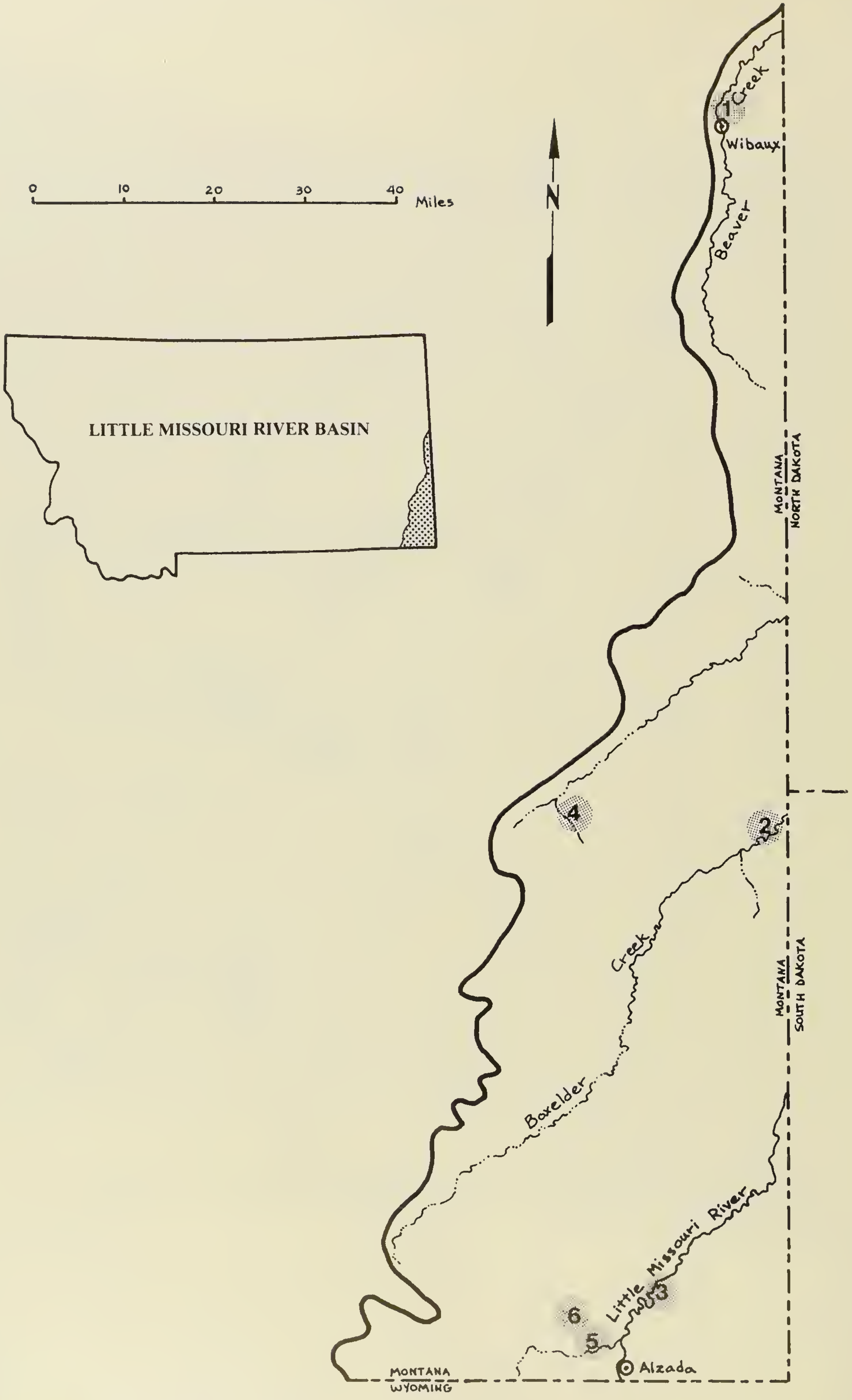
The Little Missouri River Basin covers about 3,360 square miles in extreme southeastern Montana. The basin is an area of rolling hills with gentle to moderate relief. An area of about 11 square miles in the extreme southeast corner of the basin drains into the Belle Fourche River in Wyoming and South Dakota. All of the remaining streams are tributary to the Little Missouri River, which in turn flows into the Missouri River at Lake Sakakawea, North Dakota.

The Little Missouri River Basin has a semi-arid continental climate, with cold dry winters, cool moist springs and warm summers. The average annual precipitation for the area ranges from 11 to 14 inches. Approximately 75 percent of the precipitation falls from April through September.

Most of the basin is used for dryland and irrigated crops and for range. Approximately 80 percent of the area is classified as grazing land. About 182,000 acres are under cultivation with about 42,000 of these acres irrigated. The predominant water use in the basin is for irrigation.

Surface water quality throughout the basin ranges from fair to poor. There is a heavy reliance on groundwater for stock and domestic supplies.

Map No.	Stream Segment	Drainage	Probable Impaired Use(s)	Suspected Pollutants	Pollution Sources	Reference Nos.	Severity Index
1	Beaver Cr. below Wibaux	Little Missouri R.	A,I,R	C,NH3,N,P	Wibaux WWTP,O	3,7,10	1.06 B
2	Box Elder Cr. below Mill Iron	Little Missouri R.	A,I,R	C	O	3	4.92
3	Little Missouri R. below Alzada	Missouri R.	A,I,R	C	O	3	
4	Russell Cr.	Little Beaver Cr.	A,R	C,N,P	Ekalaka WWTP	10	B
5	Thompson Cr.	Little Missouri R.	A	TSS	N,A,M	2	
6	Willow Cr.	Little Missouri R.	A	TSS	N,A,M	2	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LITTLE MISSOURI RIVER BASIN
Creek
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Wibaux
Beaver
MONTANA
NORTH DAKOTA
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Creek
MONTANA
SOUTH DAKOTA
Boxelder
Little Missouri River
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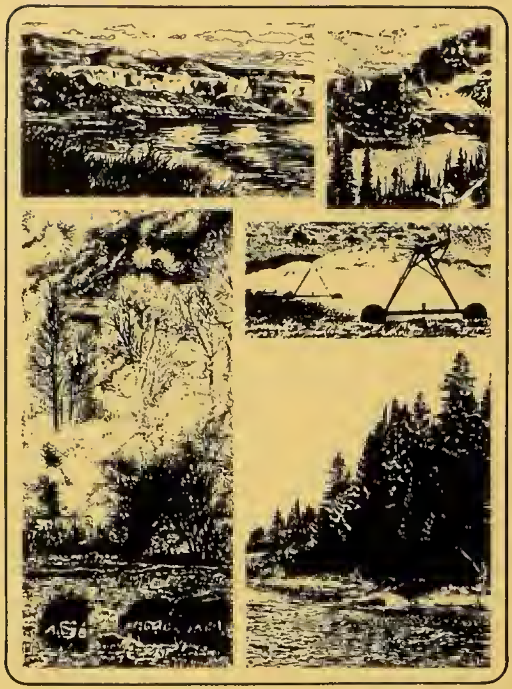
6
5
Alzada
MONTANA
WYOMING



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